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MODERN
TELEPHOTOGRAPHY

CAPT. OWEN WHEELER,
F.R.P.S.



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MODERN TELEPHOTOGRAPHY.

MODERN . . . TELEPHOTOGRAPHY.

A Practical Manual
of Working Methods
and Application.

BY
CAPTAIN OWEN WHEELER, F.R.P.S.
Editor of "The Telephoto Quarterly."

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View on the River.

Taken by Captain Owen Wheeler with Ross' "Homocentric" Lens.

Epstein 1872

Spokane gift
9-23-41



Telephotograph.

By CAPTAIN OWEN WHEELER.

Taken from the same standpoint as the view on opposite page, at about 7 Magnifications, with the same "Homocentric" Lens as Positive and Ross' $2\frac{1}{4}$ -inch as Negative.

MODERN TELEPHOTOGRAPHY.

INTRODUCTION.

THE time is approaching, if it has not actually arrived, when Telephotography ought to be regarded, not in the light of a special study only to be attempted by experts, but as a great power placed in the hands of the everyday worker. It is an unfortunate circumstance that for some sixteen years this deeply interesting and important branch of photography should have laboured under serious disqualifications. But it is useless to deny the fact that until recently it was an exceptional thing to meet with really good Telephotographs, while the operator who used a Telephoto lens with the same ready confidence with which he used, say, a wide-angle one, was practically non-existent. Even those who had studied the subject thoroughly, and were provided with first-class equipment, often hesitated to run the risk of obtaining only flat and veiled negatives as the result of a great deal of extra trouble in focussing, calculation of exposure, and keeping the camera

steady at a long extension. The result of this continued unpopularity has naturally reacted upon progress, and between 1891 and 1907 the real improvements in Telephotography were few and far between.

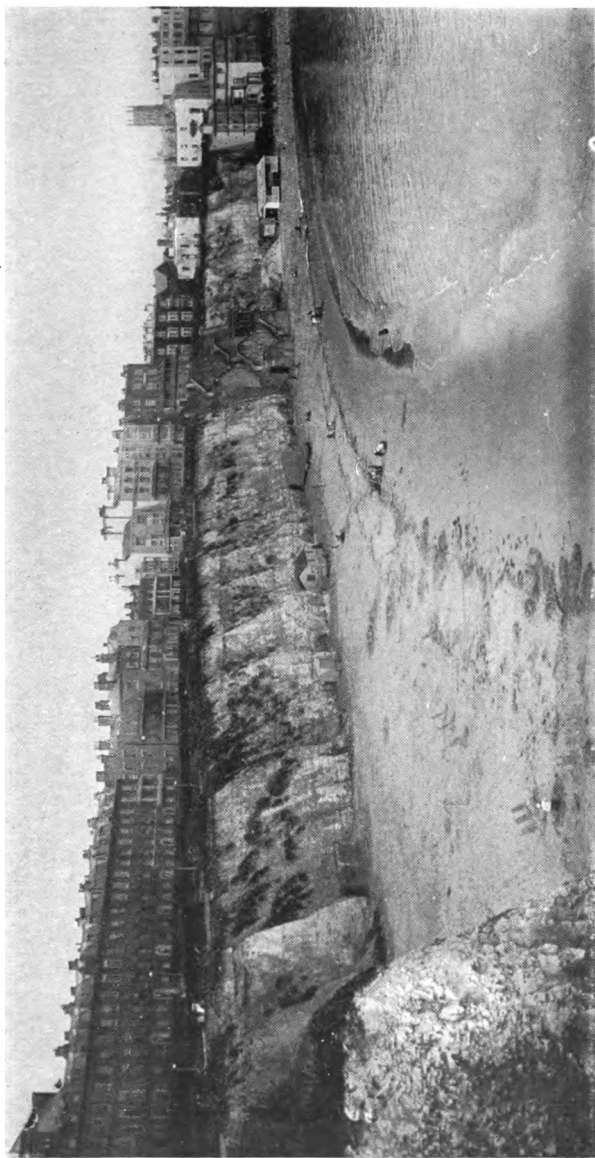
The introduction of the long hood for the purpose of removing the internal reflections, which were formerly the chief obstacle to Telephotographic success, has given the Telephoto lens a fresh start, and from this point it may confidently be expected that further progress will be rapid and significant. It is now quite possible to make a long series of Telephotographic exposures with comparative certainty of securing, at fairly high magnifications, results which can easily be mistaken for ordinary photographs. Only average skill and experience are necessary, and the additional outfit needed is by no means cumbersome or costly. Already Telephoto lenses of the very highest class are available, and several manufacturers are interesting themselves in the production of apparatus specially calculated to meet the Telephotographer's requirements.

If it be accepted that Telephotography is neither difficult nor expensive, and that a high standard of quality has already been attained in the manufacture of the special appliances which its practice necessitates, it is clear that Telephoto work has a great future before it. Apart from its truthful rendering, and the ease with which it enables its possessor to give an idea of an object

or scene sometimes pictorially superior to that which is possible when employing an ordinary photographic objective, the Telephoto lens confers a singular sense of power upon the operator who knows how to use it. If he cannot exactly annihilate distance, he can produce a very fair imitation of that feat, and, on a clear day, from some useful eminence, can often make a dozen successful and interesting exposures as against the one or two "general views" he could obtain with the average anastigmat or rectilinear.

As an example of what this added power may signify in terms of focal length, let us take the case of a very simple outfit, such as that with which I myself have done a great deal of work at moderately high magnifications, *i.e.*, up to about 14 diameters. The outfit consists of an ordinary "square-form" half-plate camera, with an extension of only about 16 inches; an ordinary half-plate lens with a focus of 7 in.; a Telephoto lens-mount; and two or three interchangeable "tele-negatives." Yet this modest equipment gives me the command of lenses of any focus I may care to select between 7 inches and a trifle over *eight feet*. Doubtless Messrs. Ross would be prepared to quote for a lens having a focus of eight feet, but few besides wealthy men would be prepared to pay for it. Again, if the picture taken by the ordinary lens were enlarged more than, at most, six diameters, the granularity of the film would produce a very unpleasing effect.

I need not here expatiate upon the special purposes which the Telephoto lens can be made to serve, and to some of which the succeeding chapters make particular allusion. The main point of this brief Introduction is to emphasise the point that Telephotography should henceforth be regarded in a different light from that in which its disabilities caused it to be regarded until a very short time back. It is now, to anyone who employs the Telephoto lens carefully and intelligently, a comparatively simple and certainly a most practically useful branch of ordinary photography, and I am convinced that in the near future there will be very few serious workers who will not gladly and constantly avail themselves of the astonishing facilities thus afforded. In this connection I may add a supplementary personal note. Should any readers of this little manual meet with difficulties, or be in need of information in connection with Telephotography, I shall always be glad to hear from them, and to do my best to help them, if they will address their communications to me c/o Messrs. Ross, Limited, Optical Works, Clapham Common, S.W., and put the word "Telephotography" in the corner of their envelopes.



Taken from the Clock Shelter with Ross' 7-inch "Homocentric" Lens.
Broadstairs Bay.

See next page



Telephotograph.

By CAPTAIN OWEN WHEELER.

Broadstairs Church.

From the same standpoint as the view on page 11, with Ross' "Homocentric" 7-inch $f6.3$ Lens as Positive and Ross' Negative $2\frac{1}{4}$ -inches. 7 Magnifications.

CHAPTER I.

THE TELEPHOTO LENS.

THE Telephoto Lens has now (1910) been known to the photographic world for nineteen years. Of the literature specially connected with it perhaps the most satisfying contribution in a scientific sense is the learned "Monograph on the Nature and Application of Tele-Photographic Objectives," by Dr. P. Rudolph of the firm of Carl Zeiss of Jena, to which those who desire to study the properties of the lens in detail may usefully be referred. Any elaborate account of the instrument, or explanation of its optical attributes, is outside the purpose of the present writer. The latter approaches his subject throughout from the purely practical standpoint, and will content himself with a brief description, to which will be added a simple statement of certain elementary facts necessary to the proper comprehension of the lens and its everyday working.

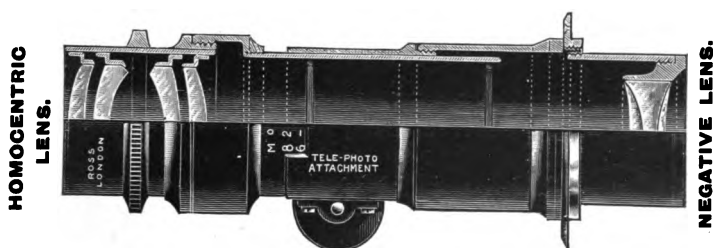
(I) CONSTRUCTION.

Although optically speaking the Telephoto lens differs from the telescope, perhaps if we begin by thinking of it as a *photographic telescope*, an appli-

ance by which objects at a distance may be photographed, we shall arrive at a conception of this interesting instrument as clear and useful as any that could be conveyed by pages of figures and diagrams. The Telephoto lens stands to the ordinary photographic lens in the same relation as that in which the telescope stands to the human eye, although, as will be seen presently, the method by which various magnifications are obtained in the former case is actually simpler and in some respects superior.

Of complete Telephoto lenses there are two principal kinds, those which are constructed throughout specially and solely for Telephotographic work, and those in which an ordinary photographic lens is converted into a "photographic telescope" by the addition of a Telephoto attachment. In both cases the principle of construction is the same. There are two systems of lenses in each, one having a positive focus and capable, therefore, of producing a photographic image, the other having only a short negative focus, and so incapable of being used as a photographic instrument. In the case of complete Telephoto lenses constructed specially and solely for Telephotographic work the "positive" element, although it *can* be employed for ordinary photography, usually produces very doubtful results, because it has been designedly left uncorrected. Such special lenses are not to be generally recommended, having regard to the fact that it is

possible to procure Telephoto attachments which work admirably with the anastigmat lenses in everyday use. As a rule, therefore, the class of Telephoto lens usually discussed in this and succeeding chapters will be that which has for its "positive" an ordinary photographic objective, such as the Ross Homocentric, the Telephoto attachment consisting of a "negative" lens suitably mounted in a tube (with rack and pinion adjustment), to which the "positive" can be readily adapted. The accompanying block gives



a clear idea of the general construction of a complete Telephoto lens of this description.

Negative lenses as used for Telephotography—tele-negatives as they are commonly called—are of relatively short focal length, always shorter, at any rate, than the focal length of the positive lens with which they are employed. It used to be the rule to recommend that in ordinary cases the tele-negative should have a focus of about half the focus of the positive lens, in other words that, in order to obtain the best results, a positive of, say,

8 inches focus should be used with a four inch negative. Practical experience has, however, shown that this rule may be safely disregarded, and that tele-negatives can often be used with positives of from six to eight times their focal length with excellent results. With this point I will deal more particularly a little later. In the meantime it is sufficient to say that the simple tele-negatives now generally available range in focal length from a little over an inch to four or five inches. They are usually plano-concave in form, and consist, as a rule, of two or three cemented lenses. When used in a Telephoto system in which the positive lens is a doublet the concave surface of a cemented tele-negative comes next to the positive lens, as shown in the block on page 15.

(2) SEPARATION.

It will be noticed that the positive and negative elements of a Telephoto system are separated by a relatively large air-space. This separation is a strictly limited one, and outside its limits the combination ceases to be a photographic instrument, or can only be used as such under certain conditions which are outside the present discussion. The limits in question are expressed by the statement—which may be regarded as the first rule in Telephotography—that in a Telephoto lens system the separation* between the positive and

* To be reckoned from optical centre to optical centre.

negative elements varies between the focal length of the positive and the difference between the focal lengths of the positive and negative. Within these limits the effect of placing a negative lens behind a positive lens is to increase the focus of the positive according to the decrease of the separation between the two elements. When the separation is equal to the focus of the positive, no lengthening of the focus takes place, and the image produced by the Telephoto combination is exactly the same size as the image produced by the positive only. But, as the separation is decreased, the focus of the combination is progressively increased, until it reaches infinity, when the other limit—the difference between the focal lengths of the positive and negative—is arrived at.

Let us take the case of a system in which the positive is a Homocentric of 7 in. focus, and the Telephoto attachment is a Ross tele-negative of $1\frac{3}{4}$ in. focus. The separation here will vary between 7 in. and $7 - 1\frac{3}{4}$ in. = $5\frac{1}{4}$ in. In practice, as magnifications of less than 3 or 4, or more than 30, are not commonly required, the actual range of separation is usually a little less than the focus of the negative element, and a mount which permits for the above-mentioned system a separation of from about $6\frac{1}{2}$ in. to $5\frac{3}{8}$ in. serves all practical purposes.

In the ordinary high-class Telephoto system, the separation is effected by a rack-and-pinion

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movement in the tele-mount. It was noted just now that the focus of the combination is *progressively* increased as the separation is decreased, and, accordingly, little more than a touch may be needed to alter the focus of a Telephoto lens from one which will give 20 magnifications to one which will give 30. This renders the adjustment of the separation in high-power Telephotography a delicate matter. Only tele-mounts, therefore, in which the rack and-pinion movement is of the best possible workmanship should be employed.

(3) EQUIVALENT AND BACK FOCUS.

It was said just now that the effect of placing, within a given separation, a negative lens behind a positive lens is to lengthen the focus. Now, if this were all that a Telephoto attachment accomplished, it would be important, for it would enable one lens to be used where, under ordinary conditions, a battery would be needed. But the essential peculiarity of the Telephoto lens is that, not only does it provide an infinite range of focal lengths, but a proportionate increase of camera extension is not needed. The reason for this is that in a Telephoto system the equivalent focus may be very long, while the back focus, or distance from the back of the lens to the focussing screen, is quite short. This circumstance has its origin in the fact that in a Telephoto lens the equivalent or nodal plane is a long way in front of the lens itself; and it is a circumstance which

is not only optically interesting, but of large practical significance, since it enables the Telephotographer—if he uses the right kind of tele-negative—to obtain a very considerable magnification with a comparatively short camera extension.

To find the equivalent or corresponding focus of a Telephoto lens when the latter is in use, and the separation has been adjusted to secure the magnification required, it is only necessary to multiply the focus of the positive lens by the number of magnifications. Thus, if a Telephoto system, in which the positive lens has a focal length of 7 inches, is used to produce 9 magnifications of the image produced by the positive lens alone, the equivalent or corresponding focus of the Telephoto combination—no matter what the focal length of the negative lens may be—is 63 inches. But the *back* focus is another matter altogether, and, in the case of the combination above referred to (a 7 in. positive and a $1\frac{3}{4}$ in. tele-negative), the camera extension required would be only 14 inches.

For, while the equivalent or corresponding focus of a Telephoto lens depends primarily upon the focal length of the positive, the back focus, or camera extension,* depends upon the focal length

* This term, "camera extension," while convenient, must not be used loosely. It means in Telephotography the effective extension, or actual interval between the negative lens and the focussing screen, and careful allowance must be made for the projection, if any, of the rear portion of the tele-mount inside the camera.

of the negative element. To find the camera extension necessary to obtain a given number of magnifications with any Telephoto lens, the focal length of the negative element must be multiplied by the number of magnifications less one. In the case just given the sum is $1\frac{3}{4}$ in. $\times (9-1) = 14$ in.

(4) MAGNIFICATION.

A variation of the rule just quoted forms another rule which is very convenient for ascertaining the magnification at which one is working, when the camera has been set up and extended, the Telephoto lens affixed, and a satisfactory picture focussed on the screen. One way of ascertaining the magnification is by measurement. To do this it is necessary to focus with the positive lens only, measure some suitable object as it appears on the focussing screen, and then find out what proportion it bears to the same object as represented by the Telephoto lens. But a simpler, and, in most cases, a more accurate method is to calculate the magnification by dividing the camera extension by the focus of the negative lens, and adding 1 to the result. If the camera extension, allowing for the projection of the Telephoto lens inside the camera, is 12 inches, and the focus of the tele-negative 2 inches, the magnification—no matter what the focal length of the positive may be—is 7.

Magnification in Telephotography is linear, and is scientifically expressed as an enlargement in

diameters, the square of which gives the enlargement in area. An object which by the positive lens only is shown on the focussing screen as measuring $\frac{1}{2}$ in. by 1 in. becomes, at 12 magnifications, 6 in. by 1 foot. Magnification is often deceptive, but, if the above rule be followed, and the camera extension is carefully measured, miscalculation is impossible.

(5) WORKING APERTURE.

To find the working aperture of a Telephoto system, multiply the aperture of the positive lens by the magnification. With the positive lens stopped to $f11$, a tele-negative of 2 inches focus being in use, and the camera extension being 16 inches, the working aperture is $f99$. This is the rule, and, for all ordinary purposes, it serves sufficiently well. But my experience leads me to doubt its infallibility, and I think it highly probable that further research will produce an improved system of stopping down Telephoto lenses. In the case of certain complete systems specially designed for Telephoto work a stop is placed quite close to the tele-negative, and it has been proposed to use a diaphragm in the long extending lens-hood which will be presently described. Any departure from the present system necessitates, of course, special calculation, and, in the meantime, the rule given above may be accepted as a good working one, with some

reservations which will be dealt with hereafter in the chapter devoted to Exposure.

(6) LIMITATIONS.

From the above it will be seen that the Telephoto Lens is a truly wonderful instrument of almost infinite theoretical capacity, the use of which is governed by rules which can be readily comprehended by anyone of average intelligence. But in practice the Telephoto lens is not without limitations, which it is desirable to state explicitly in order to prevent both disappointment and misuse of a valuable auxiliary. Of these limitations the majority are due to the simple circumstance that the Telephoto lens is really too versatile to be perfect. It may be quite within the range of possibility to construct a Telephoto system which, at a given magnification, will produce results at full aperture that will compare satisfactorily with those produced by even a high-class anastigmat. To do this it is necessary to have a specially constructed uncorrected positive in combination with a special tele-negative in which the necessary corrections are fulfilled. But even here the "full" aperture of the Telephoto system is a very different thing from the full aperture at which ordinary photographic lenses of the modern type will work.

When we come to the usual type of Telephoto system in which the positive is itself an ordinary

photographic lens, a serious obstacle to absolute efficiency occurs. The positive in question may be a perfectly corrected lens, but its corrections are calculated for its own focal length. When within that focal length another lens of peculiar properties is introduced, the original corrections cannot fail to be slightly disturbed. If the relative position of the positive and negative is liable to be shifted in order to produce a variety of magnifications, it becomes more and more impossible to construct a Telephoto system which is not in some way a compromise.

It is a gratifying circumstance that, in spite of the first of these disabilities, opticians have succeeded in producing tele-negatives which work very well with almost any good positive, and which, in conjunction with certain special anastigmat or other ordinary lenses, give results of singular excellence. As this manual has particular reference to Ross lenses, it is here convenient to state that the Ross tele-negatives are specially constructed to work with the Homocentric, the exquisite definition, covering power, and rapidity of which make it an ideal lens for Telephoto work. As an example of what a Homocentric and a Ross tele-negative will do, I may point to results which may be seen at any of Messrs. Ross's establishments, and which show an enlargement of four diameters from Telephotographs at 9 magnifications. Although the total magnification is 36 diameters the pictures

show plenty of detail, and it is obvious that a further enlargement would be possible.

With regard to varying magnifications in Telephotography I myself habitually adopt a method which I hope, in justice to opticians, will come into common practice. Instead of using only one tele-negative and varying the camera extension, I almost invariably work at one camera extension, and use different tele-negatives according to the magnification which I wish to produce. I find that one particular tele-negative, of about $2\frac{1}{2}$ inch focus, gives me six magnifications, at an extension of 14 inches, to my complete satisfaction. Another negative of $1\frac{3}{4}$ inch focus gives me a particularly well-defined Telephotograph at nine magnifications with the same extension. If I want thirteen or fourteen magnifications I leave the camera untouched, and use a tele-negative of a little over 1 inch in focal length. I earnestly advise all telephotographers to adopt this plan and to provide themselves with, at least, two, and, preferably, with three tele-negatives. These can be easily adapted to the same mount, and the improved character of the results, to say nothing of the greatly simplified calculations, will more than compensate the extra cost.

Theoretically the covering power of a telephoto lens, when a considerable camera extension is employed to give high magnifications, is very great, but in practice I find it best not to attempt Telephotographs of much more than half-plate

size with a half-plate combination in which the positive has a focus of about 7 in.

(7) INTERNAL REFLECTIONS.

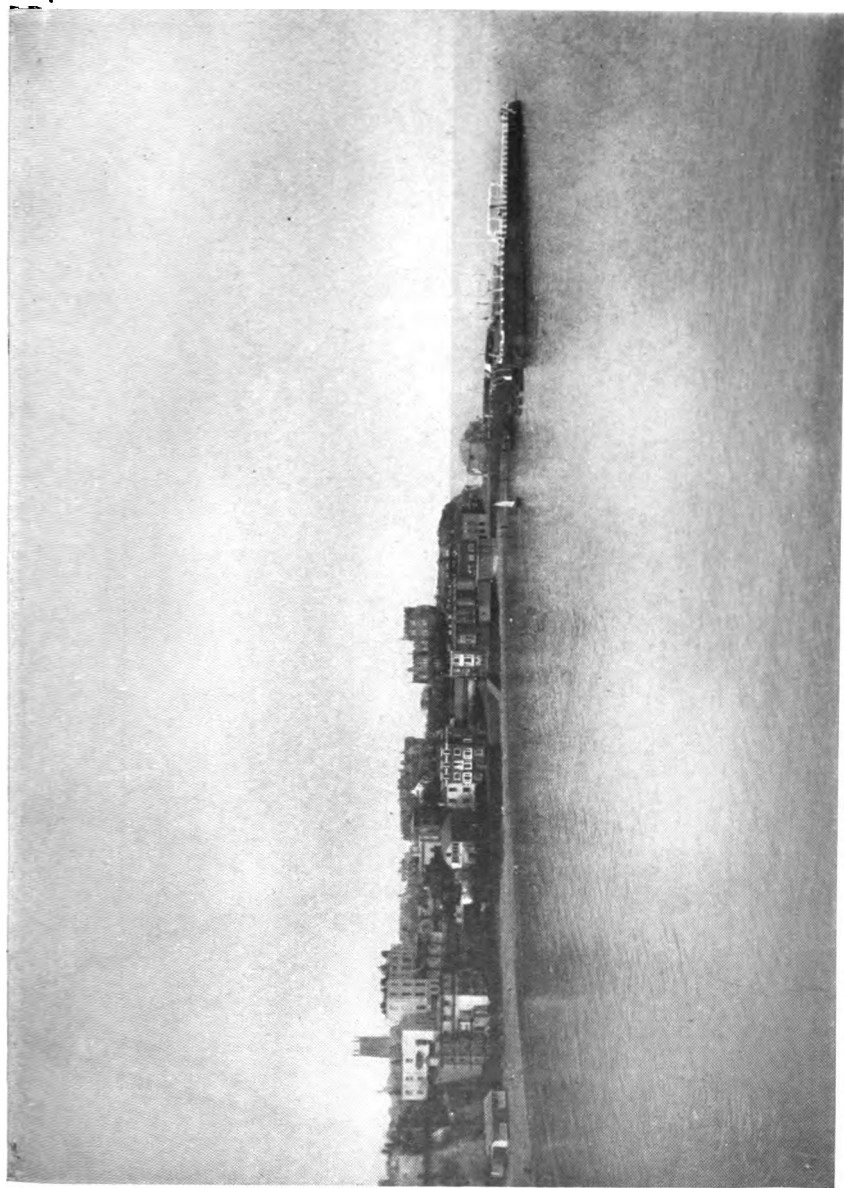
Owing to the very small angle at which the rays which go to the formation of the image enter a Telephoto lens system—an angle sometimes as small as two or three degrees—there is a great tendency towards the admission of extraneous light calculated to cause flatness and fog. Of all means of counteracting this the most satisfactory is the use of a long and preferably adjustable hood. This can be constructed in various ways, but a simple and practical form is a set of telescoping tubes in aluminium, which screws on to the ordinary lens hood. When working at very low magnifications only the largest tube should be used, or the hood should be closed in to its minimum length. The improvement effected by the use of the extended hood is very marked. Indeed, unless it is used, it is sometimes practically impossible to obtain in the open Telephotographs which could by any stretch of the imagination be mistaken—as I think that most of those here reproduced might be—for photographs taken with an ordinary lens.

CONCLUDING REMARKS.

This chapter may be fitly concluded with an appeal to new users of the Telephoto lens to be a little reasonable in their employment of an instrument which, emphatically, needs to be understood

before it can be made to respond properly to an owner's, possibly, very varied requirements. It stands to reason that a lens working at a very low aperture—seldom less than $f/16$ and sometimes as small as $f/240$, which is full of internal reflections calculated to produce exaggerated “flare”—can not be employed by a beginner without *some* risk of failure. On the other hand, there is nothing at all mysterious about Telephoto systems, and there is really no reason whatever why anyone should not become as expert with them as with ordinary photographic lenses—provided the cautions indicated in this little manual are observed.

The Telephoto lens is now available in a form greatly superior to that in which it was originally offered to the photographic world; and a little sense should be freely exercised before Telephotography is descried as “too troublesome,” or set aside as a hopeless accomplishment.



Taken from the Clock Shelter with Ross' 7-inch "Homocentric" Lens.

The Jetty, Broadstairs.

See next page

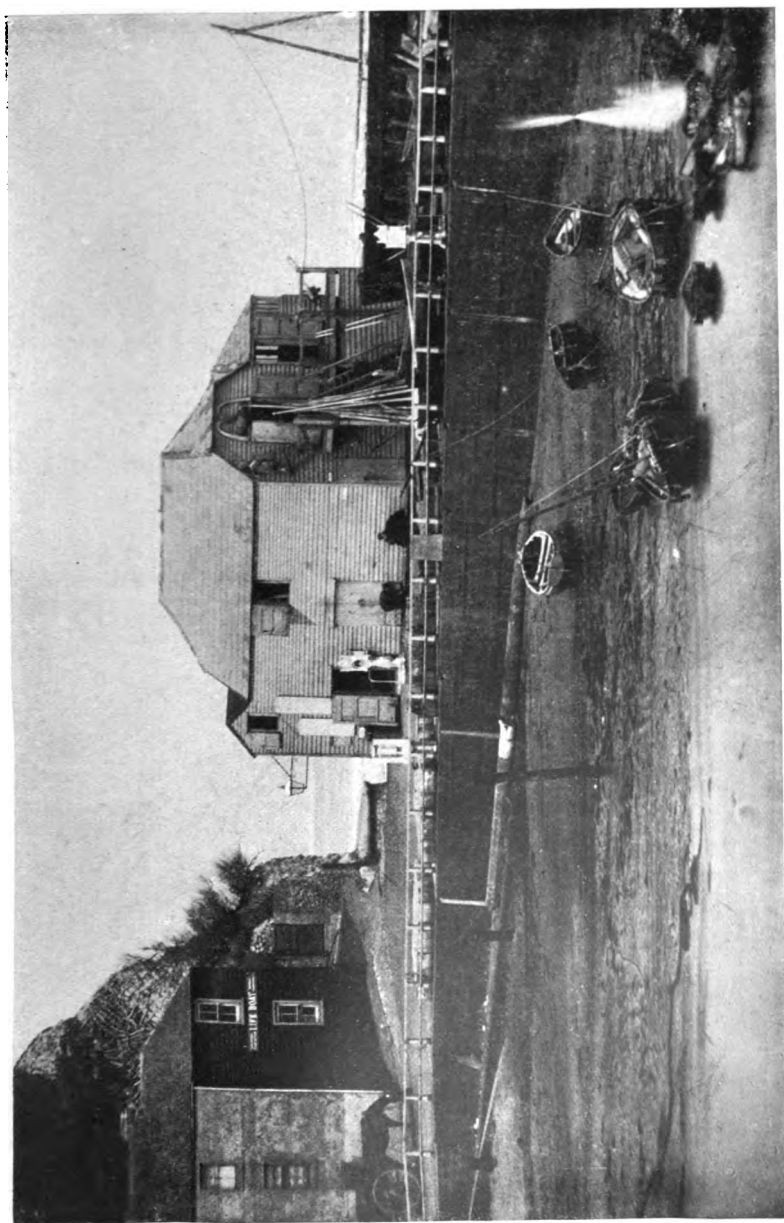


Telephotograph.

Bleak House, Broadstairs.

By CAPTAIN OWEN WHEELER.

Taken with Ross' 7-inch "Homocentric" Lens as Positive and Ross' 13-inch Negative, from the same standpoint as the Jetty on page 27.



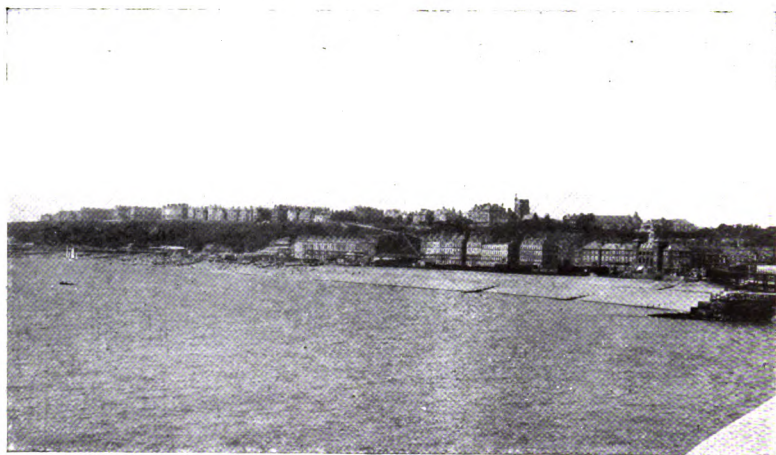
Telephotograph.

The Boat House, Broadstairs.

By CAPTAIN OWEN WHEELER.

Taken with Ross' 7-inch "Homocentric" Lens as Positive and Ross' 13-inch Negative, from the same standpoint as the Jetty on page 27.

Telephotography.



Folkestone from the Stone Pier.

The lower Picture

Folkestone Parish Church.

Taken by Captain Owen Wheeler from the same standpoint, with the same lens, Ross' 6-inch "Homocentric" as Positive, and $1\frac{1}{4}$ -inch Negative. About 12 Magnifications.



CHAPTER II.

APPARATUS AND ACCESSORIES.

ALTHOUGH the possession of good positive and negative lenses and an extending hood constitutes a very important and necessary preliminary to the successful practice of Telephotography, first-class results will not be obtainable with them, even by fairly skilful workers, unless special attention is paid to various other details in the way of equipment. In many cases where the original outfit is of a good class a photographer can take up Telephoto work without disbursing more than a few shillings in addition to the sum spent on the tele-mount, tele-negatives, and hood. On the other hand, one may have apparatus of a very complete and costly description, hardly a single item of which is of much real use in Telephotography. In such varying circumstances it is clearly impossible in a booklet of this kind to meet every individual requirement in the way of advice. Accordingly, the plan will presently be adopted of going rapidly through the details of a first-class Telephoto kit, pointing out the essential qualifications which each piece of apparatus or accessory ought to possess, and leav-

ing it to the reader to determine whether he shall make a fair start with the "best of everything," or whether aught that he has already will preclude the necessity for further outlay.

I assume that the previous chapter has been studied, and that the would-be Telephotographer is provided with a first-class positive lens, such as the Homocentric; one, two, or three tele-negatives; a tele-mount or setting; and an extending hood.

SIZE.

If a first-class positive lens is already available, it may naturally govern the size to which the photographer wishes to work. But, if no determining factor of this sort exists, I strongly recommend the average worker to take half-plate as the most satisfactory size for all Telephoto work except that of a special character, or where weight is of no great importance. Nearly all my own work is done in half-plate size, and I think that this, or $7\frac{1}{2}$ in. by 5 in., represents the largest plate the apparatus for which can be comfortably carried about by one man. For, as will shortly appear, portability in regard to cameras and stands must not be closely studied in Telephotography. By many, no doubt, 5 in. by 4 in. will be preferred, and it is possible to produce some very striking results in this size, or even in quarter-plate. But a $6\frac{1}{2}$ in. by $4\frac{3}{4}$ in. Telephotograph gives, without enlarging, a good idea of magnification, and the camera extension obtained in this size is more

generally adequate than in the 5 in. by 4 in. or 4½ in. by 3½ in.

THE CAMERA.

Those who entertain the idea of using for Telephotography a camera specially designed for portability should abandon that idea as quickly as possible if they wish to avoid constant disappointment and failure. Many of the skilfully designed and beautifully made cameras which serve for ordinary work are remarkably rigid, even at long extensions, as long as only a light lens is affixed to them. But a complete Telephoto lens of the best type is necessarily rather heavy, and constitutes a distinct strain upon the camera front. When fitted to an ordinary camera of the conical bellows variety it destroys the balance of the apparatus, and in the lightest breeze vibrations are set up which are utterly fatal to good results. Now and then one comes across specially well-made cameras with conical bellows which can be used for Telephoto work, but, in the majority of cases, they will be found to be very unsatisfactory even at short extensions, while when fully extended the addition of a Telephoto lens and hood causes them to shiver perceptibly at the least touch or breath of wind. Something may be done to remedy this defect by using some form of support or strut, and a one-legged addition to the ordinary stand is available, which serves as a special support for the lens, and affords a useful

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means of overcoming vibration. But, as it is possible to procure cameras which, even at a considerable extension, need no strut or other support, those who intend to take up Telephotography seriously will find such instruments in the long run a satisfactory investment.

Perhaps no camera will ever be designed more generally suitable for Telephotography than the ordinary "square-form" pattern with parallel bellows and double extension. Such a camera, in half-plate size, has a total extension of about 17 in., and this for all ordinary purposes is ample if a high-power negative lens is held in reserve, as recommended in Chap. I. With this extension, and a tele-negative having a focus of a little over an inch, about 14 magnifications can be obtained, and the camera remains wonderfully rigid even when fully extended. As the back is racked out from the front, the latter is the most solid portion of the structure, and will easily support the heaviest lenses. Even for ordinary work many prefer this most efficient type of camera to the more portable patterns, and those already in possession of a "square-form" may congratulate themselves on having an instrument which in itself requires no alteration or addition to enable them to produce Telephotographs of the highest merit.

The swing-back which is usually fitted to these "square-form" cameras is not often required in Telephotography, except in architectural work,

where specialists may sometimes need a somewhat greater range of "swing." Such a requirement can be duly met, but need not be discussed in relation to ordinary practice. For the rest it may, perhaps, be usefully added that there are "square-form" cameras of a variety of makes upon the market, and that some of these, made of unseasoned wood and badly put together, are of not much more use for Telephotography than a cheap conical bellows camera would be. Also, a good maker's name is a guarantee of that accuracy in the register of the dark slides, which is naturally of extreme importance even in work where only moderate magnification is sought for.

TILTING TABLES.

A tilting table is often very convenient, especially for architectural purposes, and a practical pattern will be found among the Telephotographic accessories supplied by Messrs. Ross.

THE TRIPOD.

If extreme portability must be lightly regarded in the case of the camera to be used for Telephotographic purposes, it must be absolutely put into the background in the matter of the tripod. In nine cases out of ten even a rigid tripod, which will satisfactorily support a half-plate "square-form" camera when the latter is employed for ordinary work, will be a perpetual worry to the

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Telephotographer. The only safe rule is to select a thoroughly strong, rigid pattern, and to use for a half-plate camera the same tripod which is commonly used for a camera 12 in. by 10 in., or 10 in. by 8 in., at least. Where architectural work in interiors is contemplated the usual precautions must be taken to prevent the legs from slipping (a special device for which is available), and rubber "shoes" may be used to fit over the spikes to preclude the scratching of highly-polished floors in halls where some detail of carving or moulding is required to be Telephotographed.

THE FOCUSsing CLOTH.

A really good and fairly voluminous focussing-cloth is indispensable in Telephotography, unless a focussing chamber or bag is employed. The latter is effective and practical where only low magnifications are required, but it renders the use of a focussing magnifier difficult if not impossible. Personally, I use a large waterproof focussing-cloth, which answers admirably, being absolutely opaque and readily shaped into a sort of tube when one is working at very high magnifications, and as much outside light as possible has to be excluded. A waterproof cloth is particularly useful in Telephotography, as the air is seldom clearer than it is after rain has washed away a summer haze, and one cannot always wait indoors between the showers.

FOCUSSING MAGNIFIERS.

A focussing magnifier is a necessity for all Telephotographic work except at low magnifications, and one of high-power will be found most generally useful.

ORTHOCHROMATIC SCREENS.

Orthochromatic photography is now pretty generally understood, and many workers have their own views as to the character of the screens to be used. In Telephotography a screen of medium strength is generally preferable, if only to prevent the exposure from becoming inconveniently long. The use of the extending hood renders the application of the screen to the front of the lens rather troublesome, but it can be done without much difficulty, or a tube can be made to hold the screen, and this tube can be slipped over the rear portion of the tele-mount in which the tele-negative is carried.

A very important point in connection with the use of orthochromatic screens in Telephotography is the necessity for employing none but true "optical flats." One can hardly be too careful in this matter, as the extent to which a bad screen will break down the definition of a Telephoto lens when working at high magnifications is very serious. A good plan is to have two screens, one a three-times and the other a six-times, using the former freely where there is

the least appearance of haze, and the latter to secure full orthochromatic effect.

HOOKE'S ARM.

A total camera extension of about 22 inches is about as much as can be conveniently managed by a Telephotographer without having recourse to some special means of working the rack and pinion adjustment on the tele-mount. Where a very long extension is employed the operator must either get someone to work the adjustment for him or, preferably, may use the well-known "Hook's Arm," or "Joint-Handle," which is an extremely efficient little piece of apparatus readily fitted to almost any type of camera.

The above, with the exception of the last-named item, may be described as more or less indispensable to the successful practice of Telephotography. In addition there are some accessories which will be found extremely useful, and these will either receive incidental allusion in the course of the succeeding chapters, or are included in Messrs. Ross's List.



View from Eastbourne Pier.



Telephotograph.

Albion Hotel.

By CAPTAIN OWEN WHEELER.

Taken from the same standpoint as the picture above, with the same
 Lens, Ross' 6-inch "Homocentric," as Positive, and Ross' 2 $\frac{1}{2}$ -inch
 Negative. 7 Magnifications.

Telephotography.

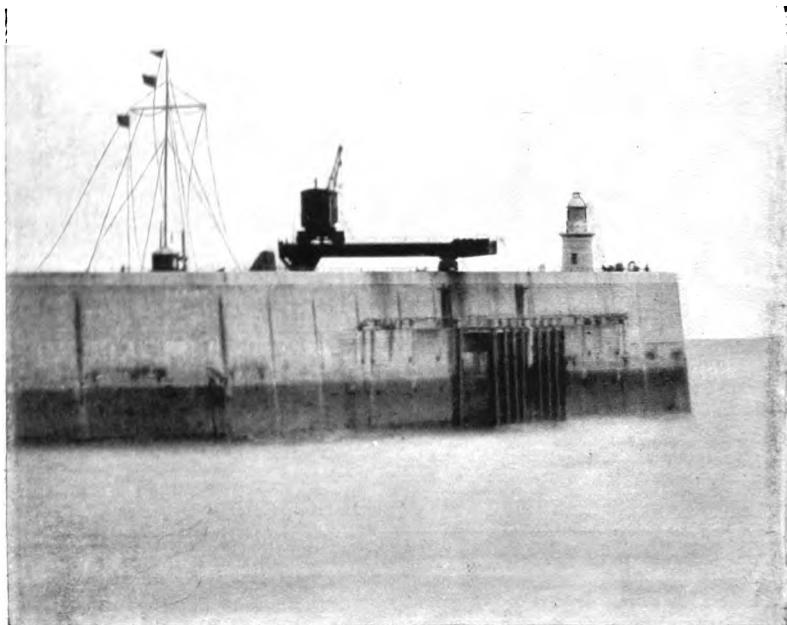


View from Victoria Pier, Folkestone.

The Lower Picture.

Folkestone Pier.

*Taken by Captain Owen Wheeler from the same standpoint, with the same lens,
Ross' 6-inch "Homocentric" as Positive, and 1 $\frac{1}{4}$ -inch Negative.
About 12 Magnifications.*



CHAPTER III.

PRACTICAL HINTS.

As a matter of fact some of the most practical hints which it is possible for me, or anyone else, to give in regard to Telephotography have already been conveyed in the course of the last two chapters. To procure first-class positive lenses, to have in use two or, preferably, three first-class tele-negatives, to employ habitually the extended hood, to make sure that camera and tripod are of the most rigid patterns, to have at hand a high-power focussing magnifier—all these are working instructions of the most practical sort, and simply to follow them will take even the beginner a long distance on the road to success. Accordingly, there is not a great deal left to be said here, except in regard to some details in which it is not altogether certain that what suits one operator may suit another. Still, my own acquaintance with Telephotography is somewhat extensive and peculiar, and, perhaps, a few allusions to methods which I have found by experience to give satisfactory results may be helpful in saving others some little trouble, disappointment, and expense.

First, as to the arrangement of one's kit, the

Telephotographer who wants to do serious work will be well-advised to keep all his lenses quite apart from his camera and slides. It is all very well in ordinary photography to carry a lens or two in one's camera case, but when, in addition to the ordinary lens, one has to provide for a tele-mount, several negative lenses, a focussing magnifier, and a hood, it is far better to make some arrangement by which, at any rate, the last four items can be kept together in a separate box or case.

As already suggested, the tele-negatives should be adapted to the one mount, and the operator should know to a nicety the capability of each. If he gets into the habit of thinking of them as A, B, and C, it may save him some trouble in calculating and recording exposures.

For the purposes of quickly ascertaining the camera extension and the magnification, some may like to carry a tape, on each edge of which a sufficient space is first allowed to represent the projection of the tele-mount inside the camera ; successive spaces are then marked off representing the exact focus of one of the tele-negatives in use, each space being numbered 0, 1, 2, 3, 4, 5, and so on. One tape will, of course, carry four such measures, and, if each measure is lettered A, B, C, or D, to represent a tele-negative of, say, $1\frac{1}{8}$, $1\frac{3}{4}$, $2\frac{1}{4}$, or 3 inch focus, the appliance will be found very useful for quick calculation where varying camera extensions are used. All that is necessary is to

lay the right measure alongside the extended camera and to read off the magnification ; or, *vice versa*, the magnification having been decided upon, the camera may be extended to the required figure on the measure.

On the subject of focussing in Telephotography a great deal has been written which I think need not have been written if the extended hood had been more generally adopted. There are some, no doubt, to whom focussing by means of a plain glass is preferable in difficult cases to the ordinary method, but I am not one of them, and, as I find it quite possible to focus at *forty* magnifications with a good ground glass screen, I personally see no reason for not using the latter. If, however, some clear glass is preferred, it is a good plan to cement a microscopic cover-glass to the ground side of the ordinary focussing screen with Canada balsam. It goes without saying that only very finely ground screens should be used for focussing in Telephotography. At high magnifications a brighter image can be obtained by smearing the screen with a little lanoline or animal fat. But, generally speaking, there is no great difficulty in focussing even in the open, provided that extraneous light is excluded from the lens by the extending hood, and a focussing-magnifier and focussing cloth of large size are used. The latter should be formed into a sort of tube during the process of focussing, and the eyes should at first be kept from six inches to a foot away from the

ground glass. When working at very high magnifications it is usually necessary to wait a minute or two before the eye can pick out any sort of image on the screen.

If the worker only possesses one negative lens and desires to vary his magnification he can, as explained in Chapter I., do so by varying both the camera extension and the separation between the negative and positive elements of the Telephoto lens system. In this case he should settle his camera extension first, and then focus finely by means of the rack and pinion adjustment which governs the separation of the lenses. Let us suppose that his only negative lens is one of $1\frac{3}{4}$ in. focus, that he has no tape measure such as is suggested in a previous paragraph, that his tele-mount projects $1\frac{1}{2}$ inches inside the camera, and that he thinks he would like to try a magnification of, say, 6 diameters. The focus of his negative lens multiplied by $(6 - 1)$ (see Chap. I.) is $8\frac{3}{4}$ in., to which $1\frac{1}{2}$ in. must be added for the interior projection of the tele-mount = $10\frac{1}{4}$ in. The camera must first be racked out to this extension and the rack and pinion adjustment on the lens then worked to obtain a sharp image. If the image is too large or small both camera extension and separation must, of course, be changed.

The possession of two or three negative lenses of varying foci renders focussing in Telephotography a much simpler process. My own method

is to use my half-plate camera almost invariably at its full extension—which, of course, I know to a nicety—and I then merely affix the negative lens which gives me the magnification I require.

When working at very high magnifications it is almost always desirable to get the image focussed preliminarily with a comparatively low-power negative, the required object being brought as nearly as possible in the centre of the ground-glass screen. Unless this precaution is taken it is no easy matter to get a small distant object on the screen at all when the magnification is 30 or 40 diameters.

The lenses used in Telephotography need to be cleaned with special care. Before screwing a fresh negative lens into the tele-mount it is as well to note particularly that the concave surface which goes inside is not in any way obscured by any dampness in the atmosphere, or through careless handling.

The serious worker should make a point of taking useful notes of every exposure, but there is no sense in making these unduly voluminous. Assuming that the Telephotographer uses habitually the same positive lens, and thinks of his negative lenses as A, B, or C, it is only necessary to add to the usual record of date, time of day, light, and exposure, some such brief entry as "Positive at $f/11$, A., 8 mags."

On the subject of plates one might say much from the standpoint of personal predilection, but

a good deal of it would be very unfair. On the subject of Orthochromatic plates, in particular, workers will always please themselves, and generally are justified in doing so. For the rest, the old rule that, where speed is no object, slow plates have certain advantages, in the way of latitude and fineness of grain, holds good in Telephotography, and I personally use wherever possible a decidedly slow "ordinary" plate of a special fine-grain series. I have obtained some very good Telephotographs on unbacked plates, but I never expose any but backed ones if I can help it. I do not myself use Orthochromatic plates and a screen for ordinary work, but in photographing distant objects, especially when there is the slightest haze, they are quite indispensable to the attainment of the best results.

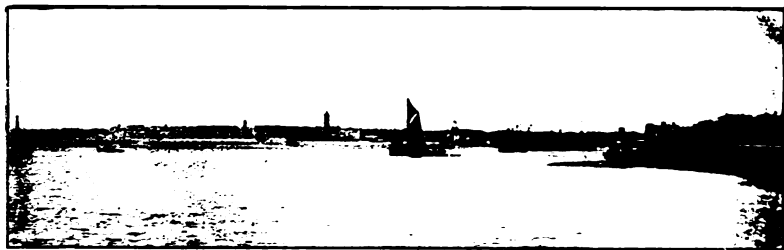
There is really little to say on the subject of development except to ask workers to disregard the instructions formerly given in most manuals of Telephotography—instructions which were needed before the extending hood was introduced but are now superfluous. Provided the hood has been used, and the exposure has been fairly accurate, fog is *not* the *sine qua non* which it used to be when the interior of the tele-mount was almost invariably, when working in the open, lit up by interior reflections. I have got veiled negatives of distant objects through over-exposure and in hazy weather, but ordinarily my Telephoto negatives are as clear as those taken with the

positive lens only, and they come up in development in precisely the same manner. Personally, I use a metol-hydroquinone developer, but this is purely an individual preference founded partly on military requirements.

It will be understood that the above remarks apply to the practice of Telephotography under ordinary conditions, and are in no sense intended to include special precautions to be observed by, or special appliances to be recommended to, those who take up Telephotography in connection with any particular study, such as Architecture, Natural History, or Engineering. Here, the writer does not feel called upon to intervene with minute instructions and suggestions, which are mostly superfluous to those who have specialized in any one branch of photographic work. The latter, having already (as a rule) mastered the practical side of ordinary photography, may safely be credited with a knowledge of the working of swing-backs and fronts, levels, hiding-tents, and other adjuncts and appliances. Indeed, it is to the specialist we have to look to carry Telephotography out of the rudimentary groove, with which a manual of this sort is chiefly concerned; for he is just the one who ought to be quick to bend the Telephoto lens to his own purpose instead of regarding it—as beginners too often do—as a freakish servant, only to be asked to do work under the most favourable conditions, and even then not always to be depended on.

These practical hints may seem rather meagre, but really there is not any need to expand them. The main thing in Telephotography is, as already indicated, to have good apparatus and to understand the broad principles on which a Telephoto lens differs from an ordinary photographic objective. When once those preliminaries are fulfilled the only real stumbling-block is exposure, and that I am treating separately in the next chapter.

Service Telephotography.



Portsmouth Harbour Entrance.



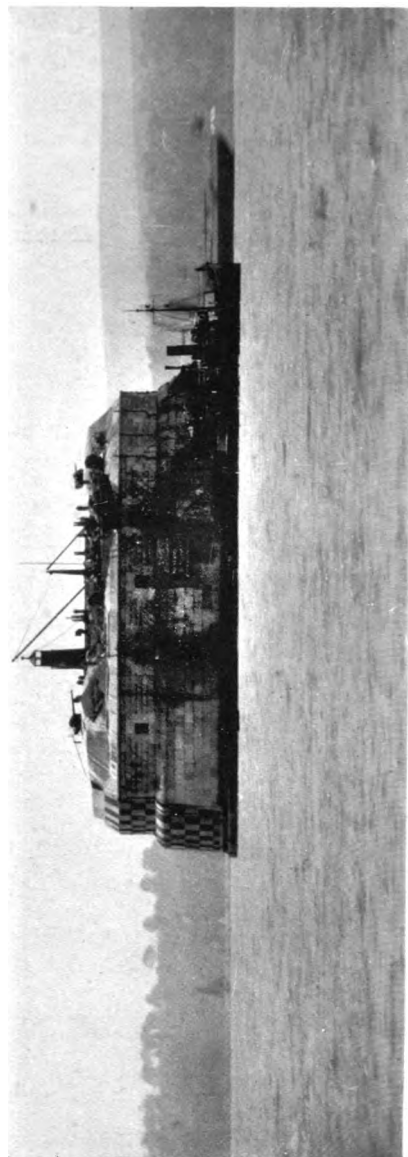
Telephotographs.

By CAPTAIN OWEN WHEELER.

From the same standpoint as the Harbour picture above, with the same 7-inch lens as Postive, and Ross' $1\frac{3}{4}$ -inch Negative. 9 Magnifications.



Service Telephotography.



Spit .Fort, Portsmouth.

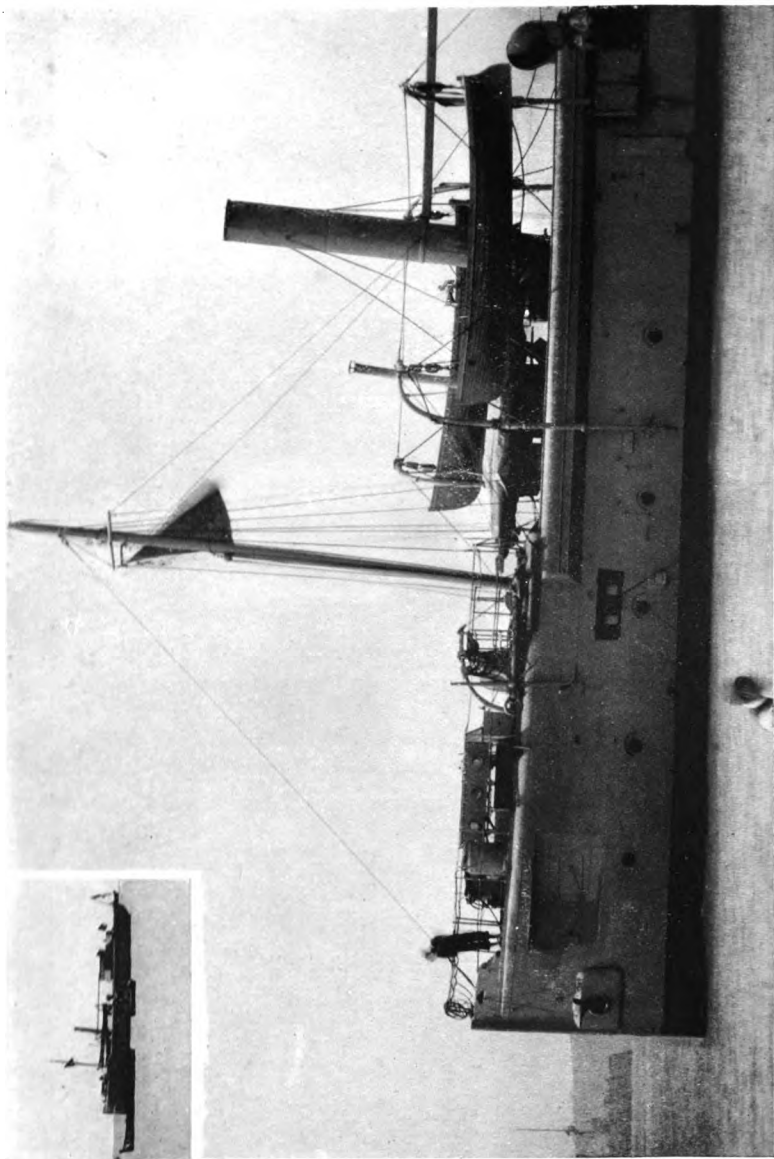
Taken by Captain Owen Wheeler, with Rose' 7-inch "Homocentric" as Positive, and 13-inch Negative
 [Name missing] 1901



Divers at Work.

Taken by Captain Owen Wheeler, with Ross' 7-inch "Homocentric" as Positive, and Ross Negative. Inset, from same point with "Homocentric" Lens only.

Service Telephotography.



A Gun-Boat.

Taken by Captain Owen Wheeler, with Ross' 7-inch "Homocentric" as Positive, and Ross' Negative. Inset from same.

CHAPTER IV.

EXPOSURE.

IT must be admitted that Exposure in Telephotography presents some difficulties, but, at the outset, it may be claimed that these difficulties are not now anything like so great as they were before the extended hood came into use. When a lens system is full of internal reflections even the correct exposure seldom gives satisfactory results, for the simple reasons that the reflections cause a sort of auxiliary exposure of the plate which has nothing to do with the proper formation of the image. In such a case any over, or under, exposure is particularly detrimental, and there is little doubt that most of the painfully inferior results which used formerly to be produced by inexperienced workers with the Telephoto lens were due to this serious drawback.

The extended hood, if it does not induce quite the same latitude as is afforded by good plates placed behind an ordinary photographic lens, certainly puts exposure in Telephoto work on quite a new footing. I am not prepared to say exactly what latitude is permissible, even in the case of the plates I generally use myself, but it is certainly very considerable, and, if one has by

mistake given double the proper exposure, there is seldom any occasion to regard the result as a certain failure. Within limits over-exposure, in ordinary photography, is preferable to under-exposure. But, as noted in the last chapter, considerable over-exposure in the case of distant objects may lead to veiled or flat results even when a long hood is used.

In any case, of course, the correct exposure is always best, and no Telephotographer should grudge a little time and trouble in getting as near as he can to absolute accuracy before he uncovers his lens. If he does not carry a note-book he should not forget to carry, in addition to some such table as that here shown, a piece of blank paper and a pencil for the purpose of the simple calculations necessary.

The general rule in Telephotographic exposures is to multiply the exposure which would be necessary if only the positive lens were used, by the square of the magnifications. For example, if the exposure for an ordinary photograph with a lens working at $f/8$ were $\frac{1}{16}$ sec., and a Telephotograph at 8 magnifications were being taken with the positive lens stopped to $f/11$, the theoretically correct exposure in the latter case would be $\frac{1}{16} \times 8 \times 8 \times 2 = 8$ secs.

Although this rule has been questioned, and alternative rules propounded, I am inclined myself to accept it as substantially correct even at

EXPOSURE TABLE.

Approximate Telephoto Exposures calculated by multiplying exposure with Positive Lens only by the square of the magnifications.

MAGNIFICATIONS.														
Exposure with Positive Lens only.	Sec.	MAGNIFICATIONS.												
		3	4	5	6	7	8	9	10	11	12	13	14	
		M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	
200	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	
150	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	
100	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	
75	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	
50	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	
35	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	
25	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	
18	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	
15	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	
12	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	
10	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	
8	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	
6	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	
5	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	
4	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	
3	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	
2	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	
1	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	

NOTE.—Allowance must be made for any stopping down and for Ortho Screen if used. It is simpler, perhaps, to do this before consulting the table. An exposure of $\frac{1}{16}$ sec. with Positive Lens only at $f/8$ would thus be reckoned approximately at $\frac{1}{4}$ sec. if the stop used is to be $f/16$ and a $\times 3$ screen is to be employed. A Telephotograph at 9 magnifications would then require 20 secs.

the higher magnifications, as to which, at one time, I doubted its accuracy. Of course, it does not hold good if slavishly followed, without any regard to the matter of distance, of which we have to take account even in ordinary photography, and which in Telephotography necessarily becomes a rather more serious consideration. For it is obvious that, merely on chemical grounds, the plain rendering on a fairly large scale of an object between which and the lens some miles of doubtfully-constituted atmosphere intervene, cannot always be satisfactorily approached by rule-of-thumb methods. Also some workers deliberately modify their exposure in order to produce a certain quality of negative. Taking, however, all things into consideration, I am convinced that the square of the magnification rule is the only correct one, and, except in instantaneous work, I habitually follow it myself.

But, apart from this, there are many subjects in which the mere multiplication of the ordinary exposure by the square of the magnifications needs to be qualified by the exercise of discrimination or plain commonsense. Let us take the case of a grey Church-tower at a considerable distance, with a number of heavy trees in the foreground. The exposure for such a subject, ordinarily speaking, would be governed largely by the necessity for showing some detail in the trees, though a compromise might be necessary to prevent the Church-tower from being merged into the sky. If

one wished to Telephotograph the Church at say 7 magnifications, and gave 49 times the exposure necessary for showing detail in the trees in an ordinary photograph, the result would certainly be serious over-exposure.

On the other hand, 49 times the exposure which would be necessary if the picture were given a quick shutter exposure with a view to getting a tiny picture of the Church for subsequent enlargement, without reference to the foreground, might be considerably under the mark for a Telephotograph at 7 magnifications. For there might be some dark portions of the tower in which detail ought to be visible in a Telephotographic record, and for this due allowance should be made.

What is essential is to make the basic calculation of the exposure required when using the positive lens only on consideration, *not* of the whole picture as shown by the positive lens on the focussing screen, but of that portion of the picture which has been selected for the Telephotograph. In some cases, where several Telephotographs are taken from, say, a commanding eminence, a different calculation may be required for each, and in no single instance may the right exposure for the Telephotograph be anything like the exposure needed for the general view multiplied by the square of the magnifications.

It is clear that these considerations render it necessary to use exposure meters in connection with Telephotography rather cautiously. But

they are of unquestioned value, if only as a general guide to the quality of the light, and many will prefer to have one in habitual use. In any case, meter or no meter, the first point to settle after selecting the object to be Telephotographed is whether it may be regarded, for exposure purposes, as being, so to speak, on all-fours with the general view. In cases where the magnification is low, or a typical part of the general view is selected, this may be the case, and the ordinary exposure as indicated by the exposure meter, or otherwise judged, may be multiplied by the square of the magnification forthwith, due allowance being made for the stop and for the orthochromatic screen when used. But, where there is any separate condition involved, it is always best to be deliberate, especially in cases where the object is at a considerable distance, and the atmosphere is at all hazy. Where the distance is very great, or is even partially shrouded in mist, half the calculated exposure for a near object is usually more than sufficient. Where the haze arises from summer heat, good Telephotographs are generally impossible. To some the appearance of the image thrown by the Telephoto lens on the focussing screen is an added help, though the brightness of that image should never be hurriedly gauged at any but very low magnifications.

In a word, correct exposure in Telephotography requires more care than is needed in ordinary

photography, and less latitude is permissible. But a little experience will show that there is not much real difficulty, and such latitude as is now given by the use of the long hood ought to be sufficient to enable most careful workers to reduce the percentage of their failures to a very low figure indeed.

APERTURE.

This seems a convenient stage at which to interpose a practical note on the subject of aperture by way of supplementing the rule given in Chap. I. In some previous text-books on Telephotography it has been laid down as a rule that an aperture smaller than from about $f/72$ should never be used, because, beyond that, diffraction sets in, and definition is interfered with. If that were so the outlook in Telephotography would be rather gloomy, because a positive lens working at $f/8$ could never be used for Telephoto work at more than 9 magnifications except at full aperture, and it is almost always necessary to stop down a little to compensate the disturbance of the corrections of the positive which the use of a tele-negative involves. Happily, as a matter of practical fact, the old rule can, within limits, be disregarded. I have before me a very fairly sharp test-negative, taken with a 7 in. lens, stopped to $f/16$ at 30 magnifications. The aperture here was $f/480$.

Using "Homocentrics" as positive lenses, I have never found any advantage in stopping them

down to a smaller aperture than $f/16$, at which excellent definition, enabling an enlargement by four or five diameters to be made of a Telephoto-graph at 9 magnifications, can readily be obtained. For ordinary purposes, $f/11$ will generally be found the best stop for a first-class positive lens combined with a tele-negative which suits it, assuming that good definition and some depth of focus are needed. But circumstances, of course, alter cases.

In some lenses the necessity for stopping down is increased by chromatic aberration, unless the latter is allowed for in the camera extension. But, as there is no need to use lenses which are not fully corrected for colour, it is hardly necessary to discuss this point closely.

CIRCLES OF ILLUMINATION.

Another point to which allusion may usefully be made here is the matter of the circles of illumination given by different Telephoto combinations under various conditions. The circle of illumination in the case of a Telephoto lens depends upon five factors:—the focal length of the positive; that of the tele-negative; the aperture at which the positive is being worked; the magnification; and the diameter of the tele-negative. There is a formula in which all these factors are taken into consideration, but information as to the plate which any particular Telephoto lens will cover is

always available from Messrs. Ross, and any worker can, of course, test his own combination by the simple process of focussing and measuring the result. At low powers a comparatively long-focus tele-negative of good diameter (Ross tele-negatives have a diameter approximately half their focal lengths) is needed to produce a circle of illumination sufficiently large to enable even a 5×4 plate to be satisfactorily covered. Those, therefore, who wish to work at three and four magnifications will do well to provide themselves with a 3 in. negative, even if only working the 5×4 size, or with one of 4 in. or 5 in. focal length, if they want to cover half or whole plates at these low powers. But, if the lowest magnification is to be four or five diameters, a $2\frac{1}{4}$ in. tele-negative will serve for 5×4 , while at six or seven magnifications a $1\frac{3}{4}$ in. will cover the plate, and give added power with the same camera extension.

The circle goes on increasing as the magnification becomes higher, until theoretically it becomes enormous. But, as hinted on page 24, the definition in these larger circles cannot be depended on, and it is far better not to strain a combination unduly, as that only means stopping down to an inconveniently small aperture, sometimes with detriment to the result.

The best rule is to have for the positive a lens which will cover the plate in use at full aperture, and to use a negative which, with this positive, shows no vignetting of the picture. If these

conditions are fulfilled, the precise circle of illumination is a matter, practically speaking, of indifference.

THE ACT OF EXPOSURE.

While on the subject of Exposure in Telephotography, it is expedient to add a word of warning as to the, apparently, trivial process of un-capping and re-capping Telephoto lenses. The writer has known frequent cases of failure due to neglect of the fact that the slightest vibration during a Telephotographic exposure may completely destroy *sharpness*, and that the "jar" of many shutters is much too great to enable them to be used satisfactorily for time exposures at even moderate magnifications. The "Compound" and "Koilos" work smoothly enough, but, as a general rule, a deep cap is preferable, and it should be removed and replaced with the greatest care.

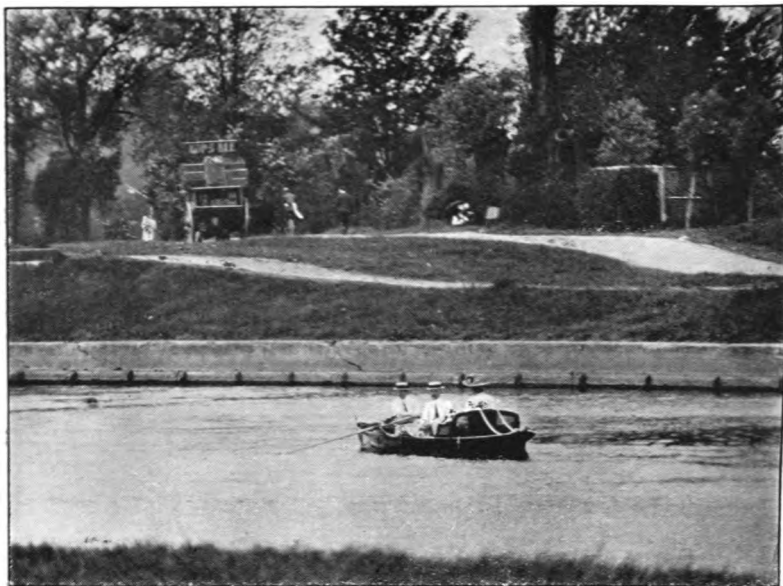


The Weisshorn.

Taken by W. E. Miller with Ross' 6-inch "Homocentric" as
Positive, and 2 $\frac{1}{4}$ -inch Negative, at 4 Magnifications.
The lower picture is from same standpoint with Ross' 6-inch
"Homocentric" only.



An Instantaneous Telephotograph.



Taken by Captain Owen Wheeler in $\frac{1}{38}$ second, with Ross' $8\frac{1}{2}$ -inch "Homocentric," $f5.6$, as Positive, and Ross' 3-inch Negative. 4 Magnifications.

CHAPTER V.

INSTANTANEOUS TELEPHOTOGRAPHY.

A PERUSAL of the preceding chapter, and a glance at the Exposure Table, will show that Telephotography does not open out a very hopeful prospect for instantaneous work. When ordinary exposures have to be multiplied by the square of the magnifications, it becomes obvious that some of the loftier flights of focal-plane shutter photography are altogether out of the question. At the same time, with care and discrimination, some remarkable results are obtainable, and interesting and important requirements can be adequately fulfilled. I am leaving to my last chapter some remarks on Instantaneous Telephotography as applied specially to naval and military purposes. But, aside from that, there are great possibilities ahead of the Telephoto lens in the matter of Press and similar work, in which it is of advantage to be able to secure a "snapshot" without coming inconveniently near the person or object it is required to photograph. Already Telephotography has been used to good purpose for natural history studies, and I am convinced that, when the Telephoto lens becomes

more widely known and better understood, its employment for instantaneous work within reasonable limitations will be very general indeed.

Before attempting to take instantaneous Telephotographs at all, one should have a clear idea of one's own capabilities as well as of one's aims. If a man has never used ultra-rapid plates in the ordinary way he ought to learn something about them before he attempts to use them behind a Telephoto lens. He may not require to use them at all if he sticks to low magnifications, when "special-rapid" plates will often meet all requirements, and meet them better than plates of the "lightning" variety, with their somewhat coarser grain and other drawbacks. But for instantaneous Telephotography at anything over 4 or 5 magnifications ultra-rapid plates are almost invariably needed, and a little previous experience with them is desirable.

Even with ultra-rapid plates, and a very fast positive lens at full aperture, the limitations of instantaneous Telephotography are soon indicated. I have, myself, succeeded in getting a fair Telephotograph of a subject, including buildings, at 9 magnifications in $\frac{1}{25}$ sec., and I think this is about as far as one can hope to get at present in the way of magnification in even moderately quick work. A simple calculation will show that a Telephotographic result of this description is equivalent to securing an ordinary photograph in about $\frac{1}{2500}$ sec., or, to put it in

another way, to making a shutter exposure with the lens stopped to about $f/32$. Both these last performances are, of course, quite possible under favourable conditions, but they place rather a strain even upon the most rapid plates.

Assuming 9 magnifications in $\frac{1}{25}$ sec. to be a limit, let us take another glance at the exposure table, and note what relation the time required for that enlargement bears to the exposure for, say, 4 and 6 magnifications. It will be seen that, as the squares of the three magnifications are, respectively, 16, 36, and 81, a magnification of 9 diameters requires about five times the exposure needed for 4, and more than twice that needed for 6 diameters. This brings Instantaneous Telephotography within the domain of practical politics, and I think the best advice I can offer to those who are thinking of taking up this branch is to confine themselves to the lower magnifications mentioned.

As a matter of fact, the results obtainable even within these limits are distinctly satisfactory from the main standpoint which has to be considered in this connection, that of equivalent focus. In Chap. I. it was explained that the equivalent focus of a Telephoto system is the focus of the positive lens multiplied by the magnifications. Accordingly, if the positive lens in use is one with a focal length of 7 in., the equivalent focus of that lens in combination with a tele-negative will be 28 in. at 4 magnifications, and 42 in. at

E.*

6 magnifications, and with lenses of these focal lengths one can stand a considerable distance from a human figure and yet get an image of quite appreciable size. It may not often be possible to use a greater speed than $\frac{1}{16}$ sec. at the higher magnification, but there are occasions when even to make a slow-shutter exposure at a distance of, say, 40 yards, from the object aimed at makes the difference between an interesting result and no result at all. On the other hand, instantaneous Telephotography at 4 magnifications presents very little difficulty if first-rate lenses and ultra-rapid plates are used, and a speed of, say, $\frac{1}{16}$ sec. is not, as a rule, exceeded.

Turning to the question of lenses, a word must be given to two types of Telephoto combination which are sometimes recommended for instantaneous work, but which I, personally, do not consider to possess any overwhelming advantages compared with their undoubted drawbacks. The first is the special form of tele-objective manufactured by Zeiss, in which a single positive of great rapidity, and uncorrected, is combined with a tele-negative having the necessary corrections to enable the whole system to be used if necessary at full aperture. The result is a system which works at $f/10$, and has a focal length of $17\frac{3}{4}$ in. Messrs. Zeiss also make a special tele-camera in which the tele-objective works at $f/10$, and has a focal length of 32 in. In both cases a quarter-plate is barely covered at full aperture. Moreover, the

combination is only corrected for the one focal length exclusively employed, and the positive lens cannot be used separately as a photographic objective.

Another type of rapid Telephoto combination is that in which a portrait lens is used as a positive lens. Theoretically a very large aperture, comparatively speaking, is a feature of this type also, but in practice I have always found it necessary to stop down considerably in order to obtain adequate results, and the rapidity then becomes no greater than, if as great as, that of a combination in which a rapid anastigmat is used. For ordinary landscape work, of course, the portrait lens is entirely useless, and, where it takes the place of the positive element in a Telephoto combination, the latter becomes rather cumbersome and costly.

There are many advantages to be gained by avoiding these special types, and using for instantaneous Telephotography a rapid anastigmat of the highest class in combination with a tele-negative preferably of large diameter, and of comparatively long focus. It must not be expected that at open aperture such a combination will cover to the margins the plate for which the positive lens alone is designed. But a 7 or 8½ in. Homocentric working at $f\ 5.6$ will, in combination with a 3 in. Ross tele-negative, give good definition over a plate 5 in. $\times$ 4 in., and, for all

ordinary purposes, these are most satisfactory and valuable combinations.

By employing the very fast Ross-Zeiss Tessars additional rapidity is procured, but in practice I find that only rarely, and then as a rule fortuitously, does a Telephoto combination in which the positive works at $f/4.5$ give any but an extremely small circle of sharp definition at full aperture.

We now come to the type of camera specially suitable for instantaneous Telephotography. It is desirable that it should be one fitted with a focal-plane shutter, as no loss of light can well be afforded even at low magnifications. For incidental work a shutter working between the lenses of the positive may in a good light be used but it should be of a very smooth-working kind, and its speed should be accurately known.

Where it is desired to use a camera with a fixed extension a special form of tele-mount can be supplied, and focussing at low magnifications can be more or less satisfactorily carried out without a focussing screen. Personally, I prefer the Reflex form of camera, and the Ross pattern in the 5 in. $\times$ 4 in. size can be recommended as a thoroughly practical instrument capable of a wide range of work, and possessing several important advantages. In particular it has an extremely rigid front, in which lenses with large aperture can easily be carried. It has an extension which enables 7 magnifications to be obtained

with a $1\frac{3}{4}$ in. tele-negative, and a camera of this description, fitted with an $8\frac{1}{2}$ in. Homocentric working at $f5\cdot6$, and a tele-mount to which the $1\frac{3}{4}$ in. and 3 in. Ross tele-negatives have been adapted, forms one of the most useful Telephoto outfits up to 7 magnifications which it is possible to find.

The reflex system of focussing works satisfactorily up to about 7 or 8 magnifications with a large aperture lens, but above that the loss of light becomes rather troublesome.

If one does not happen to possess a camera either of the "Reflex" or "Panros" type it is still possible to obtain some highly satisfactory results—provided a little extra trouble is not objected to, and a little extra care taken. The writer has done some very fair instantaneous work with a 5×4 camera of the "hand and stand" variety, having a double extension, and fitted, ordinarily, with a 6 in. "Homocentric" lens in a "Compound" shutter. To adapt an instrument of this sort for instantaneous Telephotography it is only necessary to have an alternative panel fitted with a tele-attachment carrying a 3 in. negative, and to use a direct-vision finder in place of the reflecting pattern usually fitted. The tele-attachment should have a millimetre scale in order that the approximate separation of the positive and negative elements for any particular magnification can be noted, and the positive racked out to that point before sharp focussing

is attempted. The camera bed should also be marked to indicate the point to which the bellows should be extended in order to give 3 and 4 magnifications. Anyone with a good eye for distances can sometimes secure interesting little telephotographic snapshots with a simple kit of this description, even without focussing. But it is, of course, better to have a hooded focussing screen and focus as sharply as possible before actual exposure. For beach scenes and the like this plan answers very well. An added refinement would be a pair of focussing magnifiers in the form of spectacles. The direct-vision finder is, of course, only used in order to get the picture properly on the plate, and a little practice is needed before it can be satisfactorily used for Telephotography. A camera of the kind in question can be used quite easily in the hand if not too fully extended. Naturally, if worked on a tripod the results are more likely to show crisp definition.

A Telephoto Portrait.



Taken at a distance of about 100 feet. Positive Lens,
7-inch "Homocentric," Negative, Ross $1\frac{3}{4}$ -inch. About
7 Magnifications.

Telephotography.



Folkestone Harbour Entrance.

The Lower Picture.

The Fisherman's Church.

Taken by Captain Owen Wheeler from the same standpoint, with the same lens,
Ross' 6-inch "Homocentric" as Positive, and $1\frac{1}{8}$ inch Negative.
About 12 Magnifications.



CHAPTER VI.

TELEPHOTOGRAPHY FOR SERVICE PURPOSES.

IT is the writer's intention not so much to expatiate upon the general Service value of Telephotography, as to offer a few practical suggestions or points to be borne in mind in applying it to the special requirements of the Navy and Army. Some Service uses of Telephotography will readily suggest themselves to even the lay outsider. But it is very necessary in such a connection not to jump too hastily to conclusions, and, even where the remarkable attributes of the Telephoto lens seem to indicate a particularly wide scope of naval and military utility, it is desirable to advance no claims that cannot be fully substantiated.

Let us take, for example, the matter of Telephotography from war balloons. At first sight this would seem to be a direction in which only specialization is necessary to produce results altogether in advance of any that can be obtained with ordinary photography. But in reality the problem is an extremely difficult one, for the reason that, in addition to a very quick exposure, an appreciably long equivalent focus is needed if the Telephotographic record from a *captive* balloon is to be of much practical use. In order

to show guns plainly at a distance of four or five miles a lens must have an equivalent focal length of a great many inches and this means, Telephoto-graphically speaking, even with a positive lens of comparatively long focus, a fairly high magnification, thus rendering instantaneous exposures very difficult. At any but low magnifications, again, the angle of view is very small, and many pictures may have to be taken to give a good idea of an important position. Accordingly, there is force in the contention that, for the requirements of captive war-balloon reconnaissance, the Telephoto lens may not easily supplant very long focus anastigmat, or even "rectilinear" lenses, the direct pictures obtained with which will—if contact transparencies take the place of prints—stand enlargement by six diameters.

Still, even in this direction there are interesting possibilities as to which there is, I think, good reason for hopefulness. The fact that Telephoto combinations are now available which give crisp definition at full aperture renders practicable an outfit greatly superior to that with which I originally attempted to solve this problem. The complete adequacy of such an apparatus must be a matter of lengthy experiment, and details of it are not of general interest. But it may here conveniently be stated that, putting special Service requirements apart, Messrs. Ross are in a position forthwith to supply a very useful Telephoto outfit for free and dirigible balloon purposes in the

shape of the Reflex Camera mentioned in the last chapter, fitted with specially selected lenses. If desired, this camera can be swung in the balloon in a detachable cradle, and, as it can be readily used with the positive lens only for obtaining "general views," it may be classed as an instrument of great potential Service value.

I am unable to write at all authoritatively on the subject of Telephotography for naval purposes, but I may, perhaps, be allowed to mention an outfit which has been specially designed for naval use, and of which particulars can be had on application to Messrs Ross's headquarters at Clapham Common. Essentially it is the Reflex Camera in box form fitted with a lens of which either the single or double combination can be used, while alternative tele-negatives afford a good range of additional focal lengths. The aim has been to provide a thoroughly efficient instrument so simple in its working that it can be handled by comparatively unskilled operators, and, either for naval reconnaissance, or for use in private yachts, the outfit merits, I venture to think, careful consideration.

A few words may now be said in conclusion as to the use of the Telephoto lens for purposes of ordinary reconnaissance on land, where, ordinarily speaking, length of exposure does not greatly signify. Here Telephotography can achieve results which simply cannot be obtained in any other way, and there seems no valid reason what-

ever, whether on the score of expense, or of weight, or of complexity, or of quality of results, why this powerful aid should not be utilized in every future campaign. It is, perhaps, not too much to say that the real reason why Telephotography has not been largely used hitherto for military purposes is precisely the same reason which has rendered it unpopular with the civilian worker, namely, that the flat and foggy images produced by the unhooded Telephoto lens were not worth the trouble they took to procure. That disability has now largely been removed, and a moderately skilful Telephotographer can expose plate after plate with practical certainty of success. He can do this, too, at a distance from the enemy which renders him secure from observation or bullets. Where is the general who would not appreciate a succession of Telephotographs taken at a distance of perhaps three or four miles, yet showing clearly—especially when examined with a magnifier—all sorts of details which the cleverest military draughtsman would have difficulty in transmitting to paper if he had to observe them first through a telescope?

If a military Telephotographer required a quantity of cumbersome kit there would be a double objection to his presence with a mobile force. He would take up transport, and he could not work comfortably in the only place in which he would be of any use, namely, well in front. But, as I have repeatedly urged, a Telephoto-

grapher can carry a half-plate outfit without any assistance and this, if properly selected, is quite sufficient for all practical purposes. A single mule or pony will easily bear the burden of enough materials to last for months, with a developing tent included, assuming that a special R.E. equipment is not available. Why, then, should not the smallest expedition have its Telephotographer? I venture to add my personal conviction that, with a very little encouragement, many officers and non-commissioned officers would learn how to use Telephoto lenses expertly on the chance of making themselves useful in this direction.

As a practical appendix to these observations let me state briefly what sort of Telephotographic kit ought, in my opinion, to be used for military purposes. As a matter of plain fact there is really nothing better than the half-plate outfit which I have already recommended for ordinary use. If a larger camera is thought to be necessary, as might be the case in sieges where the extra weight would not greatly matter, a whole-plate or even 12×10 camera, and a positive lens of correspondingly longer focal length might be used. But for all work done in connection with a moving force, half-plate is the best all-round size, and the results obtainable with it ought to convince even the most exacting general that a Telephoto lens properly used can sometimes be as useful as a gun.

One little detail before I bring both this Chapter and my booklet to a close. It is fitting, in connection with Service Telephotography, to draw attention to the fact that, in all cases of known dimensions, the Telephoto lens is a useful little range-finder. The formula is delightfully simple: If A be the known dimension, B the size of the image of A on the focussing-screen or in the negative, and c the equivalent focal length of the Telephoto combination, then D (the distance) = $\frac{A \cdot c}{B}$. Of course the idea is of limited application, and there is a margin of error due to the difficulty of measuring the size of the image with absolute precision, and also to the practical impossibility of gauging the exact focal length of the tele-combination. But very considerable accuracy can be attained in the case, for instance, of a warship, the length of which can be readily ascertained from various reference books.

**CAMERAS,
LENSES AND
ACCESSORIES
FOR TELEPHOTOGRAPHY.**

--- **SPECIAL** --- **REVERSIBLE FITTINGS**

To Swing-Back of Square Bellows Camera.

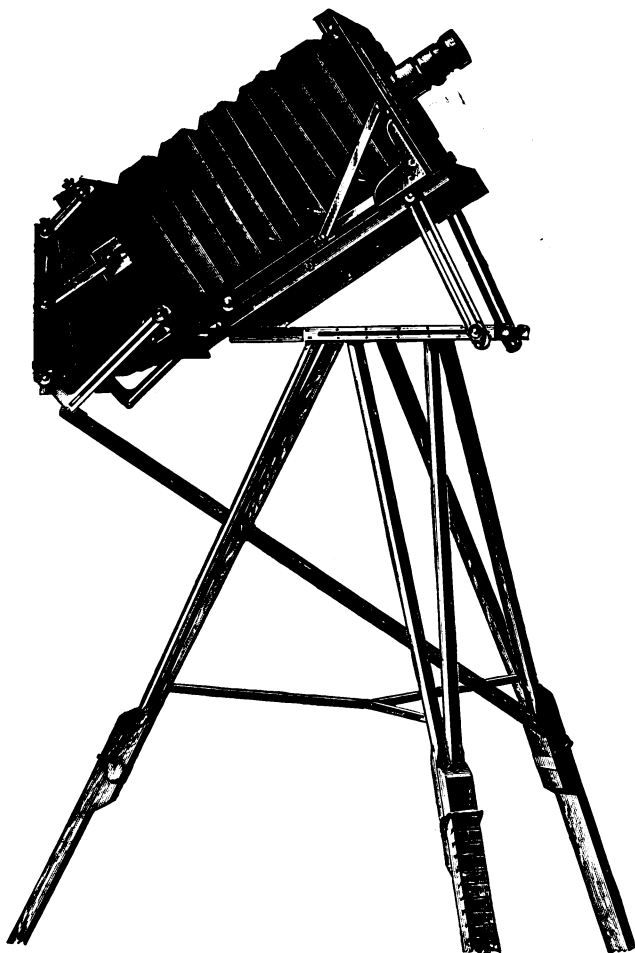
(See illustrations, pages 83 and 85.)

THERE are essentials in Telephotography to which, relatively, much greater importance must be attached than is given to them in general photography. In both cases a camera has necessarily to be quite steady during exposure, but for successful Telephoto work special precautions must be taken to ensure the whole apparatus being as rigid as it can be made, the slightest tremor precluding the possibility of anything like definition.

It frequently happens, as in Architectural work, that the camera has to be very considerably tilted upwards or downwards to obtain the picture of an object out of the axial line of sight. In order that the sensitized plate may take its proper vertical position after such tilting, recourse must be had to the swing back; and the worker equipped with an outfit of ordinary design will find frequently that he cannot give the requisite amount of motion to get the image favourably on the plate, the tilt being too great to admit of the back being brought to the perpendicular. A camera used in what may be termed a strained position, is more subject to vibration than when used in the normal manner, and to avoid all unsteadiness and to provide the tilting and swing motions necessary the apparatus illustrated, and now to be described, has been specially designed.

There is no doubt that the only satisfactory method of adaptation for the purpose of tilting is that in which the camera is carried on a substantial table fitted to the tripod stand in place of the usual

circular or triangular top. In the apparatus shown this table is provided with the most effectual means of making the tilting movements and with such arrangements that when the camera is clamped in



SPECIAL FITTINGS, with Rigid Tripod Stand and Tilting Table Top-stays, as described - - - - -	£4 10 0
Camera Support - - - - -	£1 15 0

(See illustration, page 85.)

position it becomes as one piece with the table and tripod, thus securing the utmost rigidity.

The Camera is of the usual square-bellows form, and has a back that will swing to an angle exceeding 30 deg. This remarkable result is obtained by specially-designed fittings, somewhat on the lines originally advocated, we believe, by Mr. Marriage in his book on Telephotography ; but in the present case the range of movement is greater, and the apparatus of greater adaptability. The back is carried by and adapted to swing on a pair of centrally-disposed long supporting arms which slide in fitting on both sides of the camera, and which may be drawn out and firmly clamped by milled screws in any position suitable to the amount of swing it is desired to obtain. Top and bottom stays are provided on both sides, and, as seen in the illustration, the top ones, when the camera is tilted upwards, are slotted plates of the usual form, but the lower ones are of quite special shape to permit of the longer side of the stay being folded to the side of the camera body when apparatus is closed. All the stays are attached to the Camera and rigidly clamped thereto by milled screws, and when it is desired to give the camera a downward inclination these screws are taken out and the position of the stays reversed, so that the angle-shaped plates are used at the top of the Camera back.

The table carrying the camera is two-fold, the lower part having permanently attached to it at each end substantial hinges, with one leaf free. The upper part is furnished at both ends with bushes to receive the unattached ends of the hinges, milled screws being used to fix it to same. It is thus possible to hinge the table at either end according as the upward or downward tilting is required, and this without dismantling the apparatus to effect the change.

At the side of each part of the tilting table slotted arms are arranged with clamping screws, so that the two parts may be fixed in any position in relation to one another.

An important precaution against vibration is furnished by a steadying-rod of hard wood designed to support the rear end of the Camera when extended. This rod is fitted at one end with a jointed piece by which it is attached to the Camera frame, and runs through a swivel fitting carried on a leg of the tripod, to which it may be clamped after the Camera has been focussed.

The two illustrations show the camera arranged for the downward and for the upward tilt, and it may readily be seen that, so set up, it is as free from vibration as it is possible to make it.



**SPECIAL FITTINGS, with Rigid Tripod
Stand and Tilting Table Top-stays, as
described - . . . - . . - £4 10 0**

Camera Support - - £1 15 0

(See illustration, page 83.)

EXAMPLES

of Sets of Tele-negative Lenses with suitable Setting for various sizes of pictures.

FOR $\frac{1}{4}$ -PLATE

Using 5 in. f 6.3 Positive.

		Approx. Magn. at 8 in. extension.	Price. £ s. d.		
No. 2 Setting	...		2	17	6
2½ in. Tele-negative	4½		2	5	0
1½ in. "	5½		1	15	0
1¼ in. "	8½		1	10	0
Case	...		0	7	6
			<u>£8</u>	<u>15</u>	<u>0</u>

FOR 5×4 PLATE

Using 6 in. f 6.3 Positive.

		Approx. Magn. at 10 in. extension.	Price. £ s. d.		
No. 3 Setting	...		3	2	6
3 in. Tele-negative	4½		3	5	0
2 in. "	6		2	5	0
1½ in. "	7		1	15	0
Case	...		0	12	6
			<u>£11</u>	<u>0</u>	<u>0</u>

Using Positive Lens f 4.5 instead of f 6.3 and 3A Setting, extra ... 0 5 0

£11 5 0

FOR $\frac{1}{4}$ -PLATE

Using f 6.3 Positive.

		Approx. Magn. at 15 in. extension.	Price. £ s. d.		
No. 3A Setting	...		3	7	6
3 in. Tele-negative	6		3	5	0
2½ in. "	7½		2	5	0
1½ in. "	9½		1	15	0
Case	...		0	12	6
			<u>£11</u>	<u>5</u>	<u>0</u>

FOR $\frac{1}{4}$ -PLATE

Using f 4.5 Positive.

		Approx. Magn. at 15 in. extension.	Price. £ s. d.		
No. 4A Setting	...		4	0	0
4 in. Tele-negative	4½		5	5	0
3 in. "	6		3	5	0
2½ in. "	7½		2	5	0
Case	...		0	15	0
			<u>£15</u>	<u>10</u>	<u>0</u>

ATTACHMENTS

for use with Hand Cameras of fixed extension, such as the "PANROS," with Positive Lenses mounted in focussing settings.

Telephoto Attachment, consisting of Rigid Black Oxidised Tube and Negative Lens—

		1-Plate with 5 in. Lens. £ s. d.	5×4 with 6 in. Lens. £ s. d.	Postcard with 6½ in. Lens. £ s. d.
For use with f 6.3, f 6.8, or f 5.6 lenses	1½ in. neg....	3 0 0	—	—
" f 6.3, f 6.8, or f 5.6 "	2½ in. "	3 10 0	3 10 0	3 10 0
" f 5.6 lenses	3 in. "	—	—	4 10 0

ROSS' 

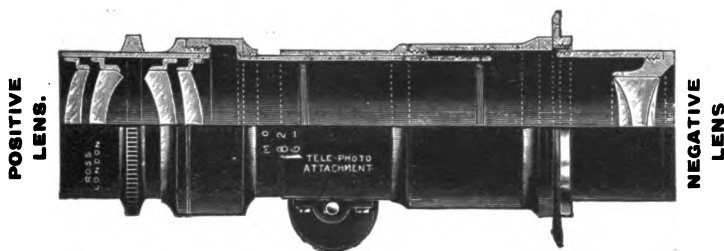
Telephotographic Lenses.

A TELEPHOTOGRAPHIC Combination consists essentially of a Positive lens and a Negative lens, the focus and consequent magnification of the image being regulated by their relative positions.

Were the separation equal to the difference of their focal lengths, a tele-scopic combination would be formed, or if the separation were equal to the focus of the Positive lens, no magnification would take place, but all approximation from this point lengthens the focus, enlarging the image. To obtain the necessary adjustments, a setting with rack and pinion is provided in four sizes to suit various Positive and Negative lenses.

Any good photographic objective may be used in conjunction with Tele-negative lenses, but the "Homocentric" is specially recommended, and it is to utilize to the full the excellent qualities of this lens that the Ross Tele-negatives have been specially constructed.

The tables given show the various magnifications, the extension of camera bellows, and the prices of the settings and Negative lenses.



Setting No. 1	for Positive Lenses, flange not exceeding $1\frac{1}{2}$ in. diameter	£3 10 0
" No. 2	" " " " " $1\frac{1}{2}$ in. "	2 17 6
" No. 3	" " " " " 2 in. "	3 2 6
" No. 3a	" " " " " $2\frac{1}{2}$ in. "	3 7 6
" No. 4	" " " " " $2\frac{1}{2}$ in. "	3 12 6
" No. 4a	" " " " " $2\frac{1}{2}$ in. "	4 0 0
" No. 5	" " " " " 3 in. "	4 10 0
" No. 6	" " " " " $3\frac{1}{2}$ in. "	5 5 0

Tele-negative Lens, $1\frac{1}{2}$ in. focus, suitable for Setting	No. 1 and larger	1 10 0
" " 1 $\frac{1}{2}$ in. "	" No. 1 "	1 15 0
" " $2\frac{1}{2}$ in. "	" " " "	2 5 0
" " 3 in. "	" No. 3 "	3 5 0
" " 4 in. "	" No. 4 "	5 5 0
" " 5 in. "	" No. 5 "	7 15 6

APPROXIMATE EXTENSIONS from NEGATIVE LENS to FOCUSING SCREEN.

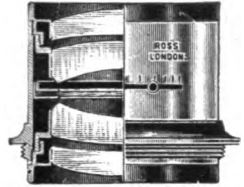
Magnifications.	5	6	7	8	Suitable for
Negative $1\frac{1}{2}$ in. focus	7	8 $\frac{1}{2}$	10 $\frac{1}{2}$	12 $\frac{1}{2}$	$3\frac{1}{2} \times 2\frac{1}{2}$ to 5×4 .
" $2\frac{1}{2}$ in. "	9	11 $\frac{1}{2}$	13 $\frac{1}{2}$	15 $\frac{1}{2}$	$4\frac{1}{2}$ -plate to $4\frac{1}{2}$ -plate.
" 3 in. "	12	15	18	21	5×4 to whole-plate.
" 4 in. "	16	20	24	28	$4\frac{1}{2}$ -plate to 10×8 .
" 5 in. "	20	25	30	35	whole-plate to 12×10

Extensions for lower or higher magnifications are proportionate to the above.

Larger size Settings and Negative Lenses of Longer Focus specially constructed to order.

Ross Lenses of Highest Efficiency

HOMOCENTRIC LENSES.



Series II. f5.6. For

Portraits, Groups, Instantaneous Pictures, and Snap Shot Hand Camera Work.

RATIO OF STOPS ... *f*5.6 *f*8 *f*11.3 *f*16 *f*22.6

No.	Equiv. Focus.	PLATE COVERED.		Price, In Iris Setting. £ s. d.	Price, In focussing Mounts. £ s. d.
		Full Aperture.	Medium Stops.		
00 ... 3 inch	...	2½ × 1½	2½ × 2	4 15 0	...
1 ... 5	...	3½ × 4½	4½ × 3½	5 0 0	5 15 0
2 ... 5½	...	4½ × 3½	5 × 4	5 10 0	6 5 0
3 ... 6	...	5 × 4	6½ × 4½	6 0 0	7 0 0
4 ... 7	...	6½ × 4½	7½ × 5	7 0 0	8 0 0
5 ... 8½	...	7½ × 5	8½ × 6½	8 10 0	The Special Focussing Mounts provided with Iris Diaphragm are for Hand Cameras of fixed extension.
6 ... 10	...	8½ × 6½	10 × 8	12 0 0	
7 ... 12	...	10 × 8	12 × 10	17 0 0	
8 ... 15	...	12 × 10	15 × 12	23 0 0	
9 ... 18	...	13 × 11	18 × 16	30 0 0	
10 ... 21	...	15 × 12	22 × 18	38 0 0	
11 ... 24	...	18 × 16	25 × 22	47 0 0	

Series III. f6.3. For

Instantaneous Views and Groups, and Snap Shot Hand Camera Work.

RATIO STOPS ... *f*6.3 *f*8 *f*11.3 *f*16 *f*22.6

No.	Equiv. Focus.	PLATE COVERED.		Price, In Iris Setting. £ s. d.	Price, In Focussing Mounts. £ s. d.
		Full Aperture.	Medium Stops.		
0 ... 4 inch	...	3½ × 2½	3½ × 3½	3 15 0	...
1 ... 5	...	4½ × 3½	5 × 4	4 0 0	4 15 0
2 ... 5½	...	4½ × 3½	6 × 5	4 5 0	5 0 0
3 ... 6	...	5 × 4	6½ × 4½	4 10 0	5 5 0
4 ... 7	...	6½ × 4½	7½ × 5	5 10 0	6 5 0
5 ... 8½	...	7½ × 5	8½ × 6½	7 0 0	8 0 0
6 ... 10	...	8½ × 6½	10 × 8	9 10 0	Focussing Mounts do not admit of be- tween-lens shutters.
7 ... 12	...	10 × 8	12 × 10	12 10 9	

Cost of Pairing Two Lenses for Stereoscopic Work, 8/-.

used as Positives for Telephotography.

COMPOUND HOMOCENTRIC LENSES.



Series IV. f 6.8. For

Outdoor Work generally; Views, Groups and Architecture.

RATIO OF STOPS ... *f*6.8 *f*8 *f*11.3 *f*16 *f*22.6 *f*32 *f*64

No.	Equiv. Focus.	PLATE COVERED.		Price, In Iris Setting. £ s. d.	Price, In Focussing Mounts. £ s. d.
		From	To		
1 ... 5 inch	...	4½ × 3½	6½ × 4½	4 0 0	4 15 0
2 ... 5½	...	4½ × 3½	7 × 5	4 5 0	5 0 0
3 ... 6	...	5 × 4	7½ × 5	4 10 0	5 5 0
4 ... 7	...	6½ × 4½	8½ × 6½	5 10 0	6 5 0
5 ... 8½	...	7½ × 5	10 × 8	7 0 0	8 0 0
6 ... 10	...	8½ × 6½	12 × 10	9 10 0	...
7 ... 12	...	10 × 8	15 × 12	12 10 0	...

LARGER SIZES TO ORDER.

Series V. f 8. For

**Views, Groups, Interiors, Copying, and Hand Camera Work,
with Large Aperture.**

RATIO OF STOPS ... *f*8 *f*11.3 *f*16 *f*22.6

No.	Equiv. Focus.	PLATE COVERED.		Price, In Iris Setting. £ s. d.	Price, In Focussing Mounts. £ s. d.
		From	To		
1 ... 5 inch	...	4½ × 3½	6½ × 4½	3 10 0	4 5 0
2 ... 5½	...	4½ × 3½	7 × 5	3 15 0	4 10 0
3 ... 6	...	5 × 4	7½ × 5	4 0 0	4 15 0
4 ... 7	...	6½ × 4½	8½ × 6½	5 0 0	5 15 0
5 ... 8½	...	7½ × 5	10 × 8	6 0 0	—
6 ... 10	...	8½ × 6½	12 × 10	8 0 0	—
7 ... 12	...	10 × 8	15 × 12	10 10 0	—
8 ... 15	...	12 × 10	18 × 16	13 10 0	—
9 ... 18	...	13 × 11	22 × 18	18 10 0	—
10 ... 21	...	15 × 12	25 × 22	24 10 0	—
11 ... 24	...	18 × 16	30 × 24	31 10 0	—

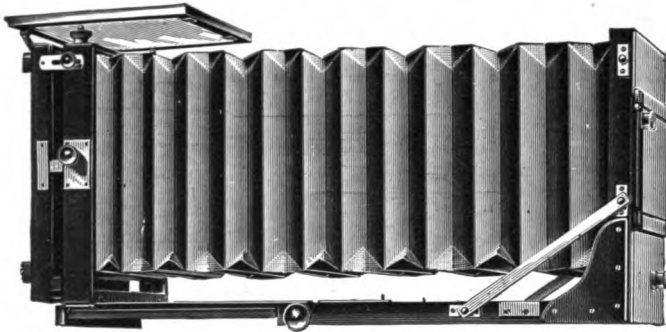
Cost of Pairing two Lenses for Stereoscopic Work, 8/-.

IMPROVED PORTABLE SQUARE BELLOWS CAMERA.

Suitable for Telephotography on Large Size Plates.

Double Extension with Reversing Holders.

The $7\frac{1}{2} \times 5$ Size extends from 3 to 17 ins.



Prices, including two Fronts or Lens Boards and Double Swing Back :—

Size.	Price of Camera only.	Brass Binding extra.	Double Dark Slides each.	Brass Binding Dark Slides each.	Rack & Pinion to double Swing Back.
5 × 4 ...	£6 0 0	£0 15 0	£0 18 0	£0 5 0	£0 10 0
6½ × 4½ ...	7 5 0	0 15 0	1 2 0	0 5 0	0 10 0
7½ × 5 ...	7 10 0	0 15 0	1 2 0	0 5 0	0 10 0
8½ × 6½ ...	9 10 0	0 15 0	1 5 0	0 5 0	0 10 0
10 × 8 ...	10 0 0	1 0 0	1 12 0	0 6 0	0 15 0
12 × 10 ...	11 10 0	1 10 0	2 0 0	0 6 0	0 15 0
15 × 12 ...	13 10 0	1 15 0	2 15 0	0 7 6	1 0 0
18 × 16 ...	22 0 0	2 10 0	3 10 0	0 10 0	1 0 0

TRIPOD STANDS.

Three-fold Jointed Ash Tripod, with sliding legs, very firm and rigid, with 6 in. Mahogany Top for $\frac{1}{2}$ -plate ...	£ s. d. 1 5 0
Ditto with 10 in. Mahogany Top for whole-plate ...	1 12 6
Ditto with 12 in. Mahogany Top for 10 × 8 ...	2 2 6
Folding additional Support for attachment to Lens or front of Camera, to prevent vibration ...	0 6 0

As extreme steadiness is needed in Telephotography, this extra support is absolutely necessary for cameras being used at long extension.

TILTING TABLE.

To fit either Cameras with Turntables or Cameras with Solid Baseboards.

For Cameras with Plain Baseboards ...	£ s. d. 0 13 6
For Cameras with Turntables ...	0 16 6

CAMERAS FOR INSTANTANEOUS TELEPHOTOGRAPHY.

The latest Self-closing Focal Plane Camera.

Made throughout at ROSS' Optical Works, Clapham Common.

ROSS' "PANROS"

(PATENT.)

is the most perfect type of Hand Camera, and has been constructed to meet the demand for a folding Camera of the highest class, suitable for all the requirements of up-to-date photography.

It will be found reliable under all circumstances and efficient in every emergency that is likely to arise.

The "PANROS" is compact and of convenient size, light in weight and easy of manipulation. Its freedom from mechanical complication, combined with most careful construction, is such that it cannot be easily deranged or damaged without unduly rough usage.

The **Lens Board** has extensive rise and fall, so that the foreground may be limited, and high buildings or monuments included in the picture.

A **Cross Movement** is also provided for horizontal pictures.

One Winding Head sets the Shutter and regulates for Time and Instantaneous exposures of varying duration, so that the Camera is **without any other external projection**. It is unlike other Cameras in this respect as also in the advantage of re-adjustment of the blinds for speed **either before or after** setting the Shutter.



Prices of ROSS' "PANROS" Focal-plane Cameras.

	1-plate with 5 in. lens.	5 x 4 6 in. lens.	Post Card. 6½ in. lens.
"PANROS" Focal-plane Camera with Ross' Patent "Homocentric" Lens, Series III., f6.3, in focussing Mount, Self-closing Focal-plane Shutter for time or Instantaneous Exposures, three solid Double Dark Slides and Black Leather carrying case	£ s. d. Code Word Pandus 12 17 6	£ s. d. Code Word Pandora 14 0 0	£ s. d. Code Word Pancreas 14 10 0
Ditto with Series IV. f6.8 "Compound Homocentric" lens instead of Series III....	Pango 12 17 6	Pangoat 14 0 0	Pangalo 14 10 0
Ditto with Series II. f5.6 "Homocentric" lens instead of either of the above	Pannaur 13 17 6	Pancrrete 15 15 0	Pancrule *17 5 0
Additional Double Dark Slides ... each	0 12 6	0 13 0	0 14 0
Mackenzie-Wishart Daylight Slides, Model B ... each	0 9 6	0 12 6	0 12 6
Envelopes for ditto ...	0 1 6	0 2 0	0 2 0
Holder to take Premo Film Pack ...	0 12 6	0 15 0	0 15 0
Changing Box with 12 Sheaths ...	1 15 0	2 0 0	2 10 0
Antinous Release, specially fitted ...	0 4 6	0 4 6	0 4 6
Light Wooden Tripod Stand ...	0 18 6	0 18 6	0 18 6
Aluminium Stand—extra light ...	1 5 0	1 5 0	1 5 0
Telephotographic Attachment, consisting of Black Oxidised Rigid Tube and Negative lens—			
for use with f6.3, f6.8 or f5.6 lenses—1¼ in. Negative lens	3 0 0	—	—
for use with f6.3, f6.8 or f5.6 " 2¼ in. " "	3 10 0	3 10 0	3 10 0
for use with f5.6 lenses " 3 in. " "	—	—	4 10 0
†Extensions for use with Back Combination of lens and with Telephotographic Attachment ...	1 10 0	1 10 0	1 10 0
Colour Screens in Cells to fit settings of f6.3 and f6.8 lenses	0 5 6	0 6 0	0 6 6
f5.6 lenses	0 6 6	0 6 6	0 7 0
Yellow Glass Light Filters of Special Glass, f6.3 & f6.8 lenses	0 11 6	0 13 0	0 15 0
f5.6 lenses	0 15 0	0 15 0	0 17 6
Extra-Best quality Leather Sling Case, hand-sewn, with Spring Lock and Sling Shoulder Strap in place of ordinary case, to hold Camera and 3 Double Dark Slides	0 10 6	0 12 6	0 12 6
Ditto, to hold Camera and Six Double Dark Slides or Camera and Changing Box ...	0 15 0	0 17 6	0 17 6

* The Series II. Lens on Post-card size Camera is 7 in. focus.

† A small charge is made for adapting Extensions to Customer's own Cameras.
Cameras without Lenses are charged 25/- extra.

CAMERAS FOR INSTANTANEOUS TELEPHOTOGRAPHY.

NEW . .
MODEL

REFLEX CAMERA

WITH FOCAL PLANE SHUTTER.

LIGHT - EFFICIENT - PORTABLE.



THIS new Reflex Camera is compactly and strongly made in mahogany, and covered in morocco leather. All movements and adjustments are effected from the outside.

The focussing hood is moved into position by simply raising the lid secured by a catch at top; and the front (which is particularly steady) is moved forward, carrying the Lens, by means of a milled-head on right-hand side.

The back revolves for taking pictures either way of the plate, and a rising front is provided.

From its peculiar mechanism, the mirror allows of the lens-board being racked further than is usual, so that short-focus lenses may be used.

The mirror itself is surface-silvered to afford the best definition.

Another special feature is that the tension-spring of the shutter has been done away with, the alteration of speed depending entirely upon the width of slit, and the duration of exposure is directly indicated on the dial on left hand, thus obviating all calculation.

To increase or decrease the slit, pull the upper knob slightly and turn either way, as required.

See that the notch on Setting-head (lower down) is brought opposite the white line while regulating the slit, and that the upper knob is quite home while setting the Shutter. To effect this, turn the milled head until the blinds are fully wound, and then set the mirror by drawing the pin under the carrying

handle down to the end of the slot. The release of both mirror and shutter requires but the sliding of the pin nearer the front, towards the thumb-rest behind it.

A Swing-front of special construction can be supplied with this Camera. The vertical swing is obtained by slipping off the rack at one side, allowing the front to advance; while the horizontal is effected by simply releasing the clamp screws.

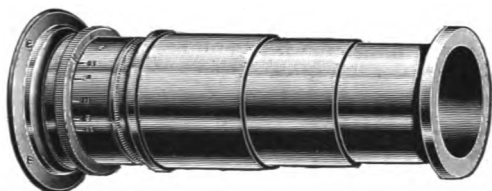
A very useful addition is the Stereo Magnifier, which attaches to the Hood, and is of great assistance in focussing. It also helps to keep the Hood well open.

Prices.	4-plate 5½-in. Lens.	Post Card Size, non- reversing 6-in. Lens.	5½ × 3½ with Stereo attachment & 2 Lenses.	5 × 4 6-in. Lens.	4-plate, 8½-in. Lens.
Reflex Focal Plane Camera, with 3 Double Slides and Ross "Homocen- tric" Lens, f63	£ s. d. 16 5 0	£ s. d. 17 0 0	£ s. d. 22 18 0	£ s. d. 22 10 0	£ s. d. 31 10 0
Code Words	Reflap.	Reflate.	Pair 5-in. Lenses Refster	Reffloor	Reffloat
Ditto, with "Homocentric" Lens, f5.6	17 10 0	18 10 0	25 8 0	24 0 0	33 0 0
Code Words	Reflin.	Refliss	Refsters	Refflitor	Refflorite
Ditto, with Ross-Zeiss "Tessar" f63	5½-in. Lens. 16 15 0	17 10 0	1½-in. Lenses 23 18 0	23 0 0	8½-in. Lens. 33 0 0
Code Words	Reflaz.	Reffextor	Refset	Reffizote.	Refflotiz
Solid Double Backs, each	0 7 0	0 10 0	0 10 0	0 10 0	0 15 0
Code Word—Reboc.					
Book-form Backs, each	0 15 0	0 18 0	0 18 0	0 18 0	1 2 0
Code Word—Reboom.					
Extra, for Swing Front (as above described)	1 10 0	2 0 0	2 0 0	2 5 0	3 0 0
Changing-Box, with 12 Sheaths	1 15 0	2 0 0	2 0 0	2 0 0	2 10 0
Film Pack Holder	0 15 0	0 18 0	0 18 0	0 18 0	1 5 0
Antinous Release, specially fitted	0 7 6	0 7 6	0 7 6	0 7 6	0 7 6
Stereo Focuser (as above described)	0 10 0	0 10 0	0 10 0	0 10 0	0 10 0
Extension Cone to Front, giv- ing total length of 20 inches	1 15 0	—	—	—	—
Solid Locking Leather Case, with Sling Strap, to hold Camera and 3 Double Backs	1 0 0	1 2 0	1 8 6	1 8 6	1 14 0
Ditto, to hold Camera and 6 Double Backs	1 6 0	1 7 0	1 12 0	1 12 0	2 0 0

Special Tropical Model of polished Teak, with Brass Binding and Russia Leather Bellows, see Ross' Catalogue, 1910.

TELESCOPIC HOOD,

Attaching to and extending in front of the Telephotographic Combination to exclude extraneous light.



THIS adjunct is indispensable for satisfactory focussing and judging the correct exposure.

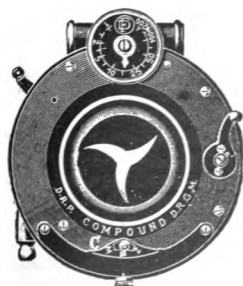
Without it fog invariably asserts itself, but with its proper application focussing may be done as sharply and development effected with as clear a result as when a picture is taken with positive lens only.

Japanned Aluminium Extending Hood from 15s.

BETWEEN-LENS SHUTTERS

Of most patterns may be employed in Telephotography. Two of the most convenient are the

“COMPOUND” and the “KOILOS.”



“COMPOUND.”

PRICES.

“Compound” from 35/- according to the size of the lens to which it is adapted.

“KoiLOS” from 35 -

— —
Full particulars in Ross' Photographic List.



“KOILOS.”

Hook's Joints and Handles for focussing from the back of the Camera and avoiding vibration from 15s.

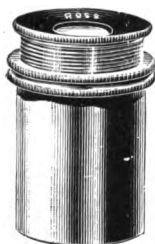
LIGHT FILTERS

TO RENDER THE TRUE VALUE OF DENSITY IN COLOURS.

Of special yellow glass, mounted in bronze metal rims to screw into the front cell of lens.

Dia. of Lens.		5 times exposure.			10 times exposure.		
Not exceeding	$\frac{9}{16}$ inch	£	s.	d.	£	s.	d.
"	"	0	8	6	0	9	0
"	"	0	10	6	0	11	0
"	"	0	11	6	0	12	6
"	"	0	13	0	0	14	0
"	"	0	15	0	0	16	6
"	"	0	17	6	0	19	0
"	"	1	0	0	1	2	0
"	"	1	2	0	1	4	6
"	"	1	10	0	1	13	0

ROSS' FOCUSSING MAGNIFIERS.

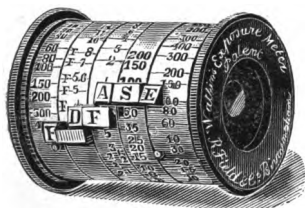


Finest Achromatic Magnifier, with Screw Adjustment and Clamping Collar.

Brass Mount, in pull-off case	...	...	£0 15 0
Aluminium	"	"	1 0 0
Ordinary Magnifiers	...	...	5/- to 0 10 6

EXPOSURE METERS.

"WATKINS'."



THE "STANDARD" METER.

A very necessary adjunct to the Photographic Outfit in the Field, and for ascertaining the correct exposure required. At first sight the instrument appears somewhat complicated, but if carefully studied for a few moments, in conjunction with the pamphlet sent out with each, it will be found wonderfully simple. In practice it is thoroughly reliable.

The "Standard Pattern" is absolutely complete with every Scale for Enlarging and advanced work.

"STANDARD" METER IN BRASS, NICKELLED, 15/-.

"STANDARD" METER IN MAGNALIUM, 21/-.

EXPOSURE METERS, &c.

"WATKINS'."

THE "BEE" METER.

A substantial watch-shaped instrument. Nickel-plate Case with snap lid and glass dial. Wears indefinitely. Size, $1\frac{1}{2}$ inches. Takes the usual disc refills.

No Calculating. One Movement sets it.

Absolutely simple in construction and use. Available for all outdoor and indoor use, including portraits, interiors, and difficult subjects; also copying and enlarging, with a little extra calculation.

Price, 2/6 each.



THE "QUEEN BEE" METER.

Silver-plated, with Ivoryine Dial, and special fittings, in Leather Case for the pocket.

The simplicity and convenient working of scales of the "Queen Bee" makes us prefer this construction to the previous Dial Meter. There is nothing to get out of order.

Price, 10/6 each.

Extra White Dial, 1/-; Refills, 6d.

Both Bee Meters can be had to order fitted with a special U.S. Dial, marked for American Cameras, at same price.



THE "WATKINS" FOCAL-PLANE METER.

For Hand Camera Work.

This Meter is identical in mechanical construction, sensitive paper and tint, with the "Bee" Meter, the arrangement of scales being slightly different to enable shutter speeds (exposure) to be read against stops, so that the user can either see at a glance what speed is required for a given stop, or what stop should be used with a given shutter speed. The speeds are up to $\frac{1}{4000}$ instead of $\frac{1}{5000}$ in the "Bee" Meter.

The various dials for the "Bee" Meter are *not* applicable to this Meter.

The indicated exposure is half the standard adopted for the "Bee" Meter, as a minimum exposure only is usually practicable. An actual test of the light by the sensitive paper in the Meter is required. Three conditions, or factors, have to be taken into consideration, and a number, or value, assigned to each; They are:—

PLATE—The sensitiveness of the plate.

STOP—The Diaphragm or Stop used.

LIGHT—The actinic force of the light falling on the subject.

Price, 3/6 each.



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